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REPORT

OF THE

REFRACTORIES COMMITTEE

VOLUME—I

DEPARTMENT OF STEEL

MINISTRY OF STEEL AND MINES

1971

HARI BHUSHAN
Chairman,
Refractories' Committee:

NEW DELHI
Dated 9th December, 1971

SIR,

I have great pleasure in enclosing herewith Volume I of the Report of the Refractories' Committee.

2. Amongst the terms of reference, first consideration was given to an assessment of demand and availability and in this volume, this aspect has been covered in detail with recommendations for bridging the gap between demand and availability.

3. The various Sub-Committees set up for making assessment of availability of raw materials, possibilities of standardisation of refractory shapes and specifications and the manufacture of equipment required for the refractory industry are continuing their work. In consideration of the amount of data collection and analysis required, some more time would be required before their Reports would be available. It is anticipated that recommendations covering all these aspects would be submitted to the Government by March 1972.

4. It was found that there has been no effort made so far to have at one point of reference important data relating to demand and availability of refractories. It has meant that a mass of data had to be compiled, sifted and analysed. All possible information and data on demand and supply, category-wise, norms of consumption etc. have now been collected at one place for ready reference to the present Report. While projections of demand and availability have been made for a period of 15 years, data pertaining to the next 5 years has been based on better known factors and can be considered as more reliable. So far as projection for 10 years and particularly 15 years is concerned, it had to be obviously based on a large number of assumptions. In any case, even for shorter term projections, it would be necessary to have the figures in the Report up-dated on an annual basis. I would suggest that the Refractories Panel under the Ministry of Industrial Development where there is representation of Department of Steel, DGTD, the Refractory Manufacturers and the Steel Plants be the coordinating agency for carrying out this work. The most appropriate time for such stock taking could be around January/February every year. Since the Panel meetings are normally held once every 2 months, one or two meetings every year could be wholly devoted to the task of updating the Report so that the situation is under constant review.

5. It has been a great pleasure for me to be associated as Chairman of this Committee and I am indeed grateful to the Department of Steel for affording me this opportunity.

Yours faithfully,
(HARI BHUSHAN)
Senior Industrial Adviser

To

The Secretary,
Department of Steel,
NEW DELHI.

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CHAPTER 1

HISTORICAL DEVELOPMENT OF REFRACTORY INDUSTRY IN INDIA

Fire clays being the most commonly used and easily handled of all refractory materials and since steel technology had also not made the strides that it has recently done, the refractory industry in all countries started with the manufacture of fire bricks. In our country fire clay deposits of the Bengal-Bihar area were the first to be utilised for manufacture of refractories. M/s Burn & Co. took up manufacture of fire bricks in their Raniganj Works in 1874. The Jabalpur works of the same firm was established in 1890. Until the establishment of Tata Iron & Steel Co. in 1907 these were the only two producing units for refractory bricks needed for general use. The setting up of Iron & Steel making plant by Tata resulted in an increase in demand for various qualities of refractories. M/s Kumardhubi Fire Clay and Silica Works and Bengal Fire Brick Co. Ltd were set up to cater to the requirements of the Tata's plant. Since refractory grade fire clays generally occur with deposits of coal, the refractory industry had to be located in the Bengal, Bihar coal fields. When Indian Iron & Steel Co. Ltd. set up their Burnpur works in 1938 most of the refractories were obtained from indigenous sources which had developed by that time.

2. After independence, by 1950-51 i.e. the beginning of the Ist Five Year Plan, refractory industry expanded its production capacity to about 290,000 tonnes per annum which was adequate to meet the country's demand at that time. Imports were necessary only for a few specialised items. By 1955-56, the capacity had further increased to 440,000 tonnes.

3. With the setting up of the 3 public sector integrated steel plants at Rourkela, Bhilai and Durgapur, the country embarked on an ambitious steel development programme which required the necessary support from the refractory industry. The requirements of refractories for the steel industry in 1960-61 were estimated to be 506,000 tonnes. Adding to these, the estimated requirements of other industries which were also developing at a fast rate a production target of 800,000 tonnes was envisaged to be achieved in that year. To achieve this production, the capacity target was fixed at one million tonnes which was more than double the capacity of the industry in 1955-56.

4. The progress of the industry during the second plan was quite impressive. Its production increased from 220,000 tonnes in 1955-56 to 550,000 tonnes in 1960-61. Installed capacity rose from 440,000 tonnes to 820,000 tonnes during the same period.

5. Despite the growth of the refractory industry, it could not, however, keep pace with the requirements of the expanding steel industry, particularly construction requirements. Besides, the three plants being set up with the technical collaboration of three different countries insisted on different specifications, shapes and sizes. This resulted in steel plants importing refractories from the countries with whose assistance these were set up. Imports of approximately 3.7 crores worth of refractories were made in 1957.

6. The Third Plan envisaged a capacity target of 10 million tonnes of steel ingots i.e. by 1965-66. The capacity and production targets for the refractory industry were, therefore, envisaged at 2 million tonnes and 1.5 million tonnes respectively to be achieved by 1965-66. The actual capacity and production of steel achieved by 1965-66 was much below the target. The actual Results achieved against the targets set for refractories was also correspondingly lower being 1.24 million tonnes capacity and 700,000 tonnes production. The capacity and production of the industry rose to 1.36 million tonnes and 750,000 tonnes respectively in 1967-68. The shortfall in fulfilment of the targets was due to the steel capacity having not increased as anticipated. In fact the industry suffered from over capacity and insufficient demand during the period of recession, the same way as most of the other indtustries. The effect of recession was far-reaching. Finances of the refractory units were badly affected, its growth, diversification rehabilitation and modernization were neglected. Orders were often booked at unremunerative prices. The result was, that when the industry was later called upon to increase its supplies and improve quality with few exceptions, it failed to do so.

7. The Refractories Panel set up by Ministry of Industrial Development and Company Affairs in connection with the formulation of the development programme of this industry in the Fourth Plan made an assessment of capacity and production of refractories in June 1968 and in the then prevailing circumstances felt that the installed capacity of 1.36 million tonnes

was sufficient and no additional capacity was required for meeting the requirements of refractories during the Fourth Plan period, particularly of the standard types.

8. Technology for production of refractories has been developed by several countries with progressive specialisation to keep pace with the progressively more stringent quality requirements demanded by steel makers. The refractory industry in our country as in other sectors of industry, has taken technical assistance from several countries like USA, West Germany, UK Czechoslovakia and Poland. There are nearly a dozen plants in the country working with foreign collaboration. The industry is still dependent on foreign know-how and about 60% of the total production is from the plants working with foreign collaboration. It should be our endeavour, that after the current collaboration agreements have run their period validity, there would be an indianization of the know how backed up by adequate research and development efforts and better knowledge of our own raw materials.

9. While the general qualities of fire clay, basic and silica refractories are being produced in the country, due to lack of know-how special refractories like fusion cast refractories, high alumina refractories, spraying compounds etc. are not being manufactured in the country. The refractory industry is conscious of international development on these lines and is endeavouring to acquire know how so that it could produce these quality refractories.

CHAPTER 2

REFRACTORIES COMMITTEE

With the anticipation that indigenous supply would be adequate to meet the demand of refractories in the country, import of refractories was banned by the Government in November 1965 and it was also decided that for the construction of phase I of Bokaro Steel Plant, 98% of the requirement would be met through indigenous supplies. In 1967-68 orders were placed on indigenous manufacturers giving firm delivery schedules for a total quantity of 207,956 tonnes and imports from USSR planned for a quantity of 4130 tonnes. It, however, transpired that the indigenous suppliers were not in a position to meet Bokaro's requirement in terms of quantity, quality and delivery schedule. Several meetings were held in the Ministry of Steel with the Refractory Manufacturers' Association to devise ways and means of ensuring availability of refractories to match Bokaro's constructional requirements. As a result of these meetings, it emerged that certain minor alterations would be necessary in the specifications and inspection procedures of refractories so that the indigenous manufacturers would be able to supply at least part of the requirement. A Technical Committee was formed by Bokaro Steel under the Chairmanship of Shri K. D. Sharma, Director, Central Glass and Ceramic Research Institute for this purpose. Even after accounting for such relaxation as was permissible, it became necessary to permit import of refractories. Upto May 1971, the total imports permitted for Bokaro are 47,621 tonnes.

2. During the beginning of 1969, there was prolonged lock-out in one of the main sources of supply of refractories of HSL Plants. The indigenous supply of refractories was till then just about sufficient to meet the normal and repair requirements. With this lock-out, the Steel Plants of HSL were compelled to use up the small inventories of refractories held by them and a critical situation developed in the Plants of HSL for want of refractories and furnace building activity had to be temporarily suspended. At the same time, due to greater incidence of capital repairs, there was an increase in the requirement of refractories at a time when the indigenous industry was not in a position to meet even the normal operational requirement. It, therefore, became necessary in October 1969 to amend the Import Policy to permit import of urgently needed refractories both for the existing Steel Plants and Bokaro Steel Plant.

3. The Ministry of Steel then asked HSL to make an assessment of their requirements of refractories for the next year or two, discuss it in detail with the Indian Refractory Makers Association (IRMA) and find out the extent to which the indigenous manufacturers could meet this requirement. HSL compiled details of their requirements and discussed them in detail with the IRMA at meetings held in Calcutta during December 1969-January 1970 and it was found that for the year 1970-71, import of approximately Rs. 10 crores worth of refractories would be necessary for HSL alone. It was also found that import of refractories for a similar amount may be necessary in the next year also.

4. At the same time, the Electric Steel Furnace industry made representations to the Government that the indigenous refractory manufacturers were fully booked with orders from the main Steel Plants and since the requirements of individual Electric furnace owners were small, the refractory industry was not in a position to manufacture and supply their requirements within a reasonable period of time. Many furnace owners reported that they would be compelled to suspend furnace operation unless sufficient quantities of refractories were made available to them.

5. The indigenous refractory industry had on various occasions represented to the Government that they had substantial capacity for production of refractories by the wet process and because of the preference of the Steel Plants for dry process refractories, there was increase in import of refractories. They had also felt that the standards stipulated for refractories were too stringent and did not take into account the raw materials available in the country. It was also argued on their behalf that there was considerable scope for standardisation of both specifications and sizes amongst the main Steel Plants, which would enable the refractory industry to produce bricks in less number of shapes and sizes, making it possible for them to increase production and meet the Steel Plants' requirements to a larger extent.

6. The refractory industry also complained that there was a shortage of raw materials needed by the industry, especially dead burnt magnesite. Further, raw materials which could be utilised by them for brick making like chrome ore were being exported in large quantities in preference to supply to the refractory industry.

7. To resolve all these conflicting problems and to make recommendations to Government on the steps to be taken for planned development of the refractory industry, the then Ministry of Steel and Heavy Engineering set up a Committee consisting of the following members:

1.	Shri Hari Bhushan Senior Industrial Adviser, Ministry of Steel & Heavy Engg.	CHAIRMAN
2.	Shri T.R. Anantharaman, Superintendent (Refractories), Central Engg. & Design Bureau, Hindustan Steel Ltd., Ranchi.	*Member.*
3.	Dr. V.G. Bhatia, Economic Adviser, Ministry of Steel and Heavy Engg.	*Member.*
4.	Dr. S.P. Varma, Industrial Adviser, Directorate General of Technical Development.	*Member.*
5.	Dr. S.S. Ghosh, Deputy Chairman, Indian Refractory Makers' Association, Royal Exchange, 6, Netaji Subhas Road, Calcutta-1.	*Member.*
6.	Shri N. B. Ghosh, Senior Geologist, Geological Survey of India, 27, Jawahar Lal Nehru Rd, Calcutta-13.	*Member.*
7.	Shri J.C. Banerjee, Deputy Director, Central Glass and Ceramic Research Institute, Jadavpur, Calcutta.	*Member.*
8.	Shri B.S. Krishnamachar, Deputy Director General, Indian Standards Institution, Manak Bhavan, B.S. Zafar Marg, New Delhi.	*Member.*
9.	Shri S. Vangala, Development Officer, Ministry of Steel and Heavy Engg.	*Member Secretary.*

8. The Geological Survey of India later desired their nominee Shri N.B. Ghosh be replaced by Shri B.B. Nadgir, Senior Geologist. Upon the retirement from service of Shri J.C. Banerjee in September 1971, Dr. D. N. Nandi was nominated by the CGCRI as their representative.

A copy of the resolution setting up the Committee is enclosed as Annexure A.

9. The Committee was of the view that a substantial amount of information was available with the Indian Bureau of Mines with regard to mining leases for various raw materials needed for Refractory industry and it would be advantageous to have a representative of the Indian Bureau of Mines on the Committee. The Indian Bureau of Mines were accordingly approached and they nominated Shri G. D. Kalra, Mineral Economist for this purpose.

10. In the first meeting of the Committee held in New Delhi on 29-1-71, it was agreed that from amongst the terms of reference, first consideration should be given to the assessment of the demand and availability of refractories and the first part of the Report submitted to the Government to cover this aspect.

11. It was felt that the task set before the Committee was of very great magnitude and on aspects like standardisation of shape and specifications of refractories, availability of raw materials for the refractory industy and equipment availability for manufacture of Refractories, the work would take a considerable length of time before meaningful conclusions could be reached.

It was, therefore, decided to constitute Sub-Committees for assessing Raw Material availability for standardisation of refractories and for equipment required by the Refractory Industry. The composition of the three Sub-Committees is as follows:

I. *Raw Materials Sub-Committee.*

1.	Shri B.B. Nadgir, Sonior Geologist Geological Survey of India.	*Coordinator.*
2.	Dr. V. G. Bhatia, Economic Adviser, Ministry of Steel and Mines.	*Member.*
3.	Shri T.R. Anantharaman, Superintendent (Refractories), Central Engg. and Design Bureau, Ranchi.	*Member.*
4.	Shri G.D. Kalra, Indian Bureau of Mines, Nagpur.	*Member.*
5.	Representative of Indian Refractory Makers' Association	*Member.*
6.	Dr. D.N. Nandi, Central Glass and Ceramic, Research Institute.	*Member.*
7.	Dr. M.R. Sirkar, Alternate Member.	

II. *Standardisation Sub-Committee.*

1.	Shri B.S. Krishnamachar, Dy. Director General, Indian Standards Institution.	*Coordinator.*
2.	Dr. D.N. Nandi, C.G.C.R.I.	*Member.*
	Shri N.B. Chatterjee	*Alternate Member.*
3.	Representative from HSL	*Member.*
4.	Representative from Rourkela Steel Plant.	*Member.*
5.	Representative from Bhilai Steel Plant.	*Member.*
6.	Representative from Durgapur Steel Plant.	*Member.*
7.	Representative from Alloy Steel Plant.	*Member.*
8.	Representative from Bokaro Steel Ltd.	*Member.*
9.	Representative from Tata Iron & Steel Co.	*Member.*
10.	Representative from Indian I & S Co.	*Member.*
11.	Representative from Mysore I & S Ltd.	*Member.*
12.	Representative from Steel Furnace Association of India.	*Member.*
13.	Representative of Indian Refractory Makers' Association.	*Member.*

III. *Equipment Sub Committee.*

1.	Shri S.R. Khanna, Development Officer, DGTD.	*Co-ordinator.*
2.	Representative from the Tools Dte. of DGTD.	*Member.*
3.	Representative from IM IV Dte. of DGTD.	*Member.*
4.	Shri T.R. Anantharaman, Supdt. (Ref) CEDB.	*Member.*
5.	Representative from HSL.	*Member.*
6.	Representative from Belpahar Refractories.	*Member.*
7.	Representative from Orissa Cement Ltd.	*Member.*
8.	Representative from Bihar Fire-bricks.	*Member.*
9.	Representative from India Firebricks & Insulation Co.	*Member.*

14. Recommendations covering the work of the above Sub-Committees are expected to be available by 31-3-1972.

CHAPTER 3

REFRACTORIES AND THEIR USAGE IN STEEL PLANTS

Refractories are inorganic materials, natural or synthetic which can withstand a temperature of say, upto about 1600°C without showing any sign of fusion or melting. Refractories in general are of three types—acidic, basic and neutral. Amongst the common refractories, the fire-bricks or the alumino-silicate refractories, semisilica and silica bricks belong to the acidic type, the magnesite, dolomite and chrome-magnesite/magnesite-chrome to the basic: and chromite, carbon and graphite to the neutral type. Besides these, there are a number of special refractories like high alumina, zircon and silicon carbide which are gradually becoming popular in iron and steel industries but those of carbides, nitrides, silicides and borides types are not of any importance as yet for iron and steel industries. Fire-bricks or alumino-silicate refractories are normally classified in India into three grades—high heat duty with pyrometric cone equivalent (PCE) value (refractoriness) of not less than Orton Cone 32 (1717°C) and containing $Al_2 0_3$ in the range of 40%, moderate heat duty (Group A) with PCE of not less than Orton Cone 30 (1665°C) and $Al_2 0_3$ content of 30% minimum and moderate heat duty (Group B) with PCE of not less than Orton Cone 27 (1640°C) and $Al_2 0_3$ content of 25% minimum. All the other refractories have more or less one grade excepting with some variations in their properties according to their end uses.

2. Refractories are indispensable in the construction of all types of furnaces. Depending upon service conditions the refractories are required to satisfy mainly some or all the following characteristics:

1. High refractoriness
2. Resistance to chemical reaction
3. Ability to stand load at the working temperature
4. Abrasion resistance
5. Thermal shock resistance
6. Low permanent after-contraction or expansion and so on.

3. The iron and steel industry consumes about 65% of the total refractory consumption in the country. As such it is an important item in the manufacture of steel. There are different types of furnaces requiring different types of refractories to meet varying service conditions.

4. A steel plant consists essentially of the following furnaces:

1. Blast furnaces
2. Coke ovens
3. Bessemer converters
4. Open-hearth furnaces
5. L.D. Converters
6. Electric arc furnaces
7. Reheating furnaces
8. Soaking pits.

5. The blast furnace lining has to stand a good deal of abrasion, corrosion against slag, molten metal and gases (mainly carbon monoxide) evolved during the process. However, the above mentioned properties are not demanded by the refractories for each and every part or use in a steel plant.

6. The refractories for coke ovens are to withstand abrasion, carbon monoxide disintegration and spalling besides the volume stability at the working temperature.

7. The refractories in open-hearth furnaces are acidic or basic depending on the composition of the slag produced. There has been more or less a complete shift from acid to basic refractories

for steel making the world over. LD converters are almost universally lined with tar-bonded dolomite blocks. But of late, tar-impregnated magnesite and tempered dolomite/magnesite blocks are on experimention in many of the advanced countries of the world.

8. The temperature is the main criterion for selecting the refractories for reheating furnaces or soaking pits. However, the load bearing capacity, resistance to the reaction with mill-scale and abrasion resistance have been taken into consideration for their bottom. With the introduction of continuous casting of steel, the reheating furnaces and soaking pits will be gradually eliminated.

9. The refractories used in the ladles should naturally have the resistance against molten metal, slag and thermal shock. The checker bricks for regenerators for blast furnace stoves, open hearth furnaces and coke ovens are expected to have thermal shock resistance and corrosion resistance against the flue gas and flue dust.

10. Thus in selecting refractories for the steel industry, temperature is not the only criterion, the effects of load, thermal shock, molten metal, reaction with slag, abrasion, carbon monoxide gas and so forth are to be taken into account.

11. There are 30 Indian Standard Specifications for different types of refractories, some for general purpose and 14 Nos. out of them are according to their end uses (i.e. industrywise). Besides all these, the consumers put forward their special specifications whenever required.

12. The IS Specifications for the firebricks generally include seven characteristics, (1) PCE (2) Chemical analysis (3) Reheat (4) Underload (5) Apparent porosity (6) Cold Crushing Strength and (7) Spalling Resistance; the limits for which of course vary with the quality. For blast furnaces, properties like resistance to carbon monoxide disintegration and abrasion resistance are essential for the inwall and top bricks but only the first one is included in IS Specifications. Blast furnace used to consume firebricks alone but lately, carbon blocks and high alumina bricks are replacing the firebricks not only in the hearth bottoms but also upto lower part of the stack.

13. Coke Ovens are constructed of silica bricks, semi-silica bricks and some firebricks, about 65% being silica bricks. Both IS : 484 and IS 4812 are serving for the selection of silica bricks for coke ovens. These Specifications include among other properties sp. gr., thermal expansion, underload and porosity. Semi-silica bricks are intermediate between silica bricks and firebricks, having a higher $Si\ 0_2$ content. There is no IS specification for semi-silica bricks but there is one IS : 2043 for siliceous fireclay refractory.

14. The acid open hearth furnace used to be an ideal example which consumed all types of refractories. But the situation is changing to all basic furnaces with about 95% of the total brick used in the construction of a basic open hearth furnace being basic in type. There are Indian Standards for magnesite, chrome-magnesite and magnesite-chrome bricks. These standards, however, do not include the slag resistance and the bursting expansion properties, which are very important for the chrome-magnesite/magnesite-chrome bricks.

15. Refractories of the casting pit comprise of Sleeves, Nozzles, and Stoppers, all generally made of fireclay bricks. Out of the total fireclay brick consumption in iron and steel industry about 40% is used up here for the ladles. Recently carbon or graphite refractories for the stoppers are coming into use. It is better to have stoppers to be of higher refractoriness than the nozzles in order to get proper fitting through the pyroplastic nature of the nozzles or *vice versa*. In case of continuous casting of steel, the nozzles are of zircon as long as the billet size is comparatively smaller.

16. Checkers are very important units in iron and steel industries. The temperature in the blast furnace stoves being fairly high, higher underload values and low reheat shrinkages are required for the upper courses of the checkers, domes, the combustion chamber walls, etc. Further, these checker bricks should be resistant to alkali dust, fumes and reducing atmospheres. Now-a-days high alumina refractories are quite common for stoves, basic (forsterite) for open hearths and firebricks for coke oven checkers.

17. Refractories have thus a very important function in the iron and steel industry. Due to the changed production technology of steel making from open hearth process to the present basic oxygen process and also due to the improvement in the type as well as quality of the refractories, the consumption of refractories has fallen from 10% to about 4% of steel produced in the country during the last two decades.

CHAPTER 4

DEMAND OF REFRACTORIES

A proforma was worked out for obtaining the demand projections from the steel industry upto the end of the 5th Five Year Plan, i.e., 1978-79. This proforma (copy at Annexure B) enabled requirements to be obtained for each end use and different types of refractories. The consumers were also asked to give their preference either for wet or dry process refractories for each end use, so that a critical assessment could be made as to the precise requirements of wet and dry process refractories. The proforma was sent to the main steel plants, Bokaro, MISL, Steel Furnace Association and the Ferro Alloy Producers' Association and the requisite information obtained. In so far as Ferro Alloy producers are concerned, their annual requirements of refractories were found to be as follows:—

Fireclay (including high alumina)	540 tonnes
Basic refractories	500 tonnes

2. In view of the above small demand, it was felt that the requirements of the ferro alloy industry need not be subjected to any detailed examination and the indigenous refractory industry would be in a position to meet this requirement.

3. It was, therefore, proposed that a detailed examination be made only of the refractories needed by the main steel plants and the Electric Steel Furnaces. After obtaining this information, an examination was made to see if definite norms of consumption can be established for the 3 distinct types of refractories needed by the indutry, namely, fireclay, basic and silica. These refractories are, to a certain extent, regularly consumed during the iron and steel making operations. For instance, ladle bricks require to be replaced after regular intervals. Open Hearth Furnaces and convertors require to be relined after they have been in use for some time Further, during the operation of steel making furnaces, certain hot repairs are effected which need refractories. All these requirements have a regular pattern of consumptin which could be related to steel production. There are other requirements, however, like the relining of a blast furnace which occurs normally once in about 5 years and rebuild of coke oven batteries which occurs after about 15 years of operation. In addition, there would be new construction being carried out either in the form of expanding existing capacity or setting up new plants and such requirements cannot be obviously related to steel production. In consideration of these points, it was considered that although rough norms specific to each plant could be fixed for operational requirements, it would not be correct to work out a norm of total consumption for each quality of brick and on the basis of the envisaged steel production determine its total requirement in any year. Such an exercise may lead to unrealistic demand projections.

4. A check was, therefore, made of the consistency of the figures of demand furnished by the steel plants for operational and capital repairs. For this purpose, the actual consumption of refractories for 1970-71 was obtained from the various plants and this requirement was expressed as Kg/tonne of ingot steel produced. Thereafter, the requirements of the steel plants projected for 1975-76 were examined in relation to the anticipated steel production. A comparison of these figures is furnished in Annexure 'C'.

5. Fireclay refractories

5.1. It was noted that the consumption level in 1970-71 at IISCO works out to 60 Kg/tonne of steel produced and this high figure is due to the fact that one blast furnace was relined during that period. The consumption figure of TISCO is higher as compared to that of HSL Plants due to the fact that TISCO employs Duplex process of steel making which requires a larger quantity of fireclay refractories.

6. Basic refractories

6.1 Rourkela produces steel mainly in the basic oxygen converters whose relining requirement is for tar bonded dolomite bricks. There are only four small open hearth furnaces of 80 tonne capacity and as such, their consumption of basic bricks is low. The figures of requirement of basic bricks for Bhilai and Durgapur are higher due to the fact that in these two plants, the Open Hearth Furnaces are with basic roofs and are equipped for top blowing of oxygen. In fact, their requirement of basic bricks would go up further after the furnaces are put on top

blowing of oxygen. Further, in the case of Bhilai Steel Plant, the bottom making practice is distinct in that it is made up of only magnesite while other plans use mixture of magnesite and dolomite. As a result, Bhilai's consumption of dead burnt magnesite for fettling is also higher.

7. **Silica refractories**

7.1 The plants of TISCO and IISCO have silica roofs for their open hearth furnaces and also employ the Bessemer Process and as such, their norms of consumption of silica bricks are higher.

7.2 From the figures set out above, it could be seen that the requirements as projected by the steel plants are reasonably consistent and there is not much of a fluctuation. The requirements as furnished by the consumers were taken as their firm demand and further analysis carried out on that basis.

8. **Expert Group for assessment of demand**

8.1 To carry out a critical assessment of the demands by the steel industry and also to examine to what extent bricks made by wet plastic process could be used at least for some time in the context of substantial capacity for such bricks in the country, an Expert Group was formed consisting of the following members:

1.	Shri S.R. Khanna, Development Officer, DGTD.	*Convenor.*
2.	Shri I.C. Modi, Durgapur Steel Plant.	*Member.*
3.	Shri S.K. Mukherjee, Bhilai Steel Plant.	*Member.*
4.	Shri P.S. Sundaram, Rourkela Steel Plant.	*Member.*
5.	Shri K.S. Swaminathan, Tata Iron and Steel Co.	*Member.*
6.	Shri Gupta Roy, Indian Iron & Steel Co.	*Member.*
7.	Dr. S.S. Ghose, Deputy Chairman, I.R.M.A.	*Member.*
8.	Shri M.H. Dalmia, Orissa Cement.	*Member.*
9.	Shri J.R.K. Murthy, Harry Refractories.	*Member.*

The Group visited steel plants and had detailed discussions with Refractory Engineers. Requirements for new plants were discussed with M/s. M.N. Dastur & Co., and CEDB of HSL who are the Consultants for these plants. The group examined the requirements of Electric Arc Furnaces with the Steel Furnace Association of India.

9. As a result of this examination, the figures of demand needed some revision and the revised figures were accepted by the consumers. Consolidated statement of Demand is at Annexure D. Report of the Group is at Annexure E and details of demand are at Annexure F. In projecting future requirements, the following were assumed:

10. Bhilai expansion from 2.5 million tonnes to about 4.0 million tonnes capacity has been considered. This would require the following facilities:

3 numbers of 100 tonne convertors;
a continuous casting shop;
reheating furnaces and heat treatment furnaces.

11. The expansion of Bokaro from 1.7 million tonnes to 4 million tonnes has also been considered. For this, the additional units are:

3 coke oven batteries;
2 blast furnaces;
1-100 tonne and 2-250 tonne convertors;
battery of soaking pits;
reheating furnaces; and
heat treatment furnaces.

12. Requirements of refractories for new steel plants have also been considered. For this purpose, the basis has been a 2 million tonne plant consisting of the following units each at Hospet, Visakhapatnam and the other locations:

(i) 4 coke oven batteries;

(ii) 3 blast furnaces;

(iii) 4 convertors of 100/130 tonne capacity;

(iv) a continuous casting shop;

(v) reheating and heat treatment furnaces.

13. It is to be clarified that in case there is some change in the number of coke ovens, blast furnaces and LD convertors, it is unlikely to change materially the projections of refractories demanded. For Salem, however, the basis is as follows:

Salem: (1) 2 Electric smelting furnaces or
2 pre-reduction kilns.

(2) 2—40 T L.D. Convertors.

(3) Continuous Casting facilities.

(4) Rolling Mills.

Programme of additional steel capacity is as per Annexure 'G' and the construction schedule for integrated steel plants is at Annexure 'H'.

14. Major rebuilding and repair work, which is likely to take place in Indian Iron and Steel-Co., has also not been considered as the same was not available.

15. The advance requirements for plants to be set up beyond 1985 have been taken into consideration.

CHAPTER 5

AVAILABILITY OF REFRACTORIES

Copies of proforma were sent to the Indian Refractory Makers' Association and they were asked to make available:

(a) Requirements of refractories for their member units; and

(b) Availability of refractories for various end-uses of the steel industry.

2. The figures of availability could not be obtained by the IRMA from all their member units, as there was inadequate response from some of the members. They, however, could obtain general information from selected members who according to IRMA supply between 90 to 95% of the requirements of refractories for the steel industry. An examination of availability was, therefore, restricted to these 14 units only. In so far as the refractories needed by the refractory makers are concerned, the IRMA stated that this requirement is very small and inclusion of these figures would not materially affect the projections of availability which the Committee proposed to make.

3. **Availability of refractories.**—The installed capacity, the production capacity, the actual production in 1970 and first half of 1971 and an estimate of production from 1971 to 1975 for the firms indicated by IRMA are set out in the Annexure J. The capacity has been indicated separately for wet and dry process fireclay refractories, coke ovens and other uses in the case of silica refractories, burnt and chemically bonded in the case of basic refractories. The availability indicated in 1975 is the maximum production likely to be available from these units after taking into account the balancing/expansion schemes under way. In some cases, the anticipated production was at 100% of licensed/rated capacity or even more. It was, therefore, felt necessary to constitute an expert group to make an assessment of the capacity of some of the units to produce these refractories both quantitatively and qualitatively. This Expert Group comprised of:—

1. Shri R.N.S. Iyer,
   Senior Refractories Engineer,
   Hindustan Steel Ltd. — *Convenor.*
2. Shri S.R. Khanna,
   Development Officer, D.G.T.D. — *Member.*
3. Shri K.K. Bandhopadhyaya,
   Asstt. Superintendent (Refractories),
   Rourkela Steel Plant. — *Member.*
4. Shri M.H. Dalmia,
   Orissa Cement Ltd. — *Member.*
5. Shri K. Sen,
   Kumardhubi Fireclay and Silica Works. — *Member.*

3.1 The Group visited the 14 refractory plants during August-September, 1971, and have made an assessment of availability. Consolidated statement of availability is at Annexure 'K' and detailed Report is at Annexure 'L'. The refractory units were asked to furnish details of despatches to steel industry and to other consumers for the first 9 months of the year for fireclay basic and silica refractories. It was found that 75% of the fireclay refractories produced by these 14 units are supplied to steel industry. In addition, the steel plants were found to receive annually about 10,000 tonnes of fireclay refractories (made by the plastic process) by units other than the 14 considered. In case of Basic Bricks the availability to steel Industry was 95%. In the case of coke oven silica and other silica bricks, the percentages were 100 and 90 respectively. Availability figures to steel industry have been accordingly taken.

4. On the figures of availability stated above, in the light of detailed discussions, the following general observations are relevant:

4.1 The figures of availability indicated for the period 1971-72 assume that the pattern of production would be the same as that existing in 1970-71. This, however, is subject to change and while such a change may affect availability from an individual manufacturer the overall

total availability from the industry would alter only very slightly. For instance, a plant is capable of achieving larger production while manufacturing standard bricks than when it makes shaped bricks. Similarly, the capacity available for manufacture of silica bricks for other uses becomes substantially less when the same facility is utilised for manufacture of silica bricks for coke ovens due to larger number of shapes.

4.2 In the case of basic refractories, while capacity set up for producing burnt basic bricks could be utilised for manufacture of chemically bonded bricks, the reverse is not possible.

5. In computing future availability, letters of intent wherever issued have been taken into account. With the revival of Asian Refractories, which is now captive unit of Bokaro, the following availability is anticipated from it:

1972	9,000 tonnes
1973	18,000 tonnes
1975	25,000 tonnes

5.1 It is also estimated that the Public Sector Refractory Plant would go into production by 1975 and its build up of capacity has also been taken into account. Details of all such capacities likely to become available have been separately shown.

CHAPTER 6

ANALYSIS OF DEMAND AND AVAILABILITY OF REFRACTORIES

An assessment of availability of refractories was made in respect of 14 units by an expert group set up by the Refractories Committee. These 14 units supply between 90-95% of requirements of refractories for steel industry. Projections of availability upto 1975-76 from these units were made by this group taking into account expansion programmes envisaged by them. The DGTD had furnished details of units to whom letters of intent were granted. Availability from such units was considered for projecting availability beyond 1975-76. Some of these units become operational before that date and availability has been taken into account on the basis of projected build-up indicated by the DGTD. In addition to the 14 units studied in detail and the new units mentioned above, there is at present no other source of availability beyond 1975-76. It was assumed that after the new units reach rated capacity, there would be no possibility of additional availability from the existing units. This maximum availability was therefore considered for computing the likely shortfall between demand and availability upto 1985. Obviously the shortfall would have to be bridged by further expansion of units and by setting up of new capacity.

2. In so far as demand for Refractories is concerned, for the existing steelmaking units, projections have been made upto 1980. In addition, requirements of Bhilai expansion, Bokaro expansion and the three new steel plants at Salem, Vijayanagar and Visakhapatnam were taken into account. For future steel plants, the policy of Government that an integrated plant of 2 million tonne capacity would be set up every year after 1980, was used as the guideline in projecting demands upto 1985. Further, operational and constructional requirements of refractories for the new plants as well as the constructional requirements of those which are likely to be operational beyond 1985 have been worked out and suitably dovetailed into projections of demand. Since adequate details were not available, requirements of IISCO Expansion have not been considered.

3. On the above basis, detailed demand/availability/surplus/deficit have been prepared for the period 1971 to 1985 (table I to IV). These figures have been presented graphically also. The main points arising out of the analysis of demand and availability are as follows :

4. Fireclay Refractories.

4.1 **High alumina and high grog.**—The availability of this quality would be in excess of demand upto about 1976. With the constructional requirements of the new steel plants, coming in the demand outstrips availability quite sharply between 1977 & 1978. By 1985, the shortfall between demand and availability is likely to be of the order of 427,000 tonnes. From 14,600 tonnes in 1972, the surplus reaches a level of 71,200 tonnes in 1975.

4.2 **Lowgrog variety.**—There is likely to be a deficit of 28,800 tonnes in 1972 which increases to about 214,000 tonnes by 1985.

4.3 **Stiff Plastic refractories.**—There is a small surplus of 3,500 tonnes in 1971 which turns to a deficit of 11,600 tonnes in 1972. Availability remains short of demand all through the period 1972-85 reaching a maximum of 37,400 tonnes by 1985.

5. Basic refractories

5.1 **Burnt.**—There is a likely deficit of about 17,500 tonnes of Burnt basic bricks in 1972 which becomes a surplus of 25,700 when additional capacity becomes available partly in 1975. If this capacity becomes fully available, there would be large increase in availability and there would be a large surplus right through the period 1975 to 1979. With the pick up in demand due to new steel capacity becoming available, the surplus gets reduced progressively and by 1981, a balance is achieved between demand and supply. Beyond 1982, there is likely to be a deficit which increases progressively from 11,400 tonnes in 1982 to 30,800 tonnes in 1985.

5.2 **Chemically bonded.**—There is currently a surplus of about 9,000 tonnes of chemically bonded bricks. If the new licences and expansions agreed to are carried out, there is likely to be a large increase in availability of chemically bonded bricks and by 1977, a surplus of the order of 45,700 tonnes is reached. It remains at that level upto 1985.

5.3 **Dead Burnt Magnesite.**—From 42,500 tonnes in 1971, the deficit gets reduced to 13,500 tonnes in 1974. It increases to 18,700 tonnes in 1975 and comes down to 15,700 tonnes by 1976. From 21,000 tonnes in 1977, the deficit progressively increases to 74,000 tonnes by 1985.

6. Silica Bricks

6.1 **Coke Ovens.**—In 1971, there ought to have been a surplus of about 4,300 tonnes coke oven silica bricks. With the advancing of the constructional schedule of Bokaro coke ovens, this surplus has disappeared and there is likely to be a deficit of 14,200 tonnes in 1972. There is a surplus of 18,300 tonnes in 1973. In 1974 & 1975, the demand far exceeds availability due to the incidence of repairs of nearly all the coke oven batteries in the country and due also to the fact that Bokaro's requirement of new batteries would have to be provided for. The total deficit in these two years is 57,800 tonnes. While there may be a balanced demand and availability in 1977 & 1978, a total deficit of 15,000 tonnes is likely in 1979 & 1980. After 1981, there would be an yearly surplus ranging from 7,700 tonnes in 1981 to 11,800 tonnes in 1985. This does not, however, take into account the likely repairs to the Indian Iron batteries and the possibility of a new battery being put up at Burnpur. Further there may be incidence of repairs to some batteries during the period. It is also possible that after 1985, there may be peak demands similar to the ones likely in 1974 & 1975.

6.2 **Other than coke ovens.**—There is a deficit of about 8,500 tonnes in 1971 which increases to 21,700 tonnes by 1973. Thereafter, demand and availability tend to balance each other in 1976 and continue to remain so upto 1977. Commencing from 1978, there is a progressive increase of deficit which reaches a level of 13,800 tonnes by 1985.

TABLE

Demand, availability surplus/deficit of refractories during
1971—1985

(Figures in '000 Tonnes)

ABBREVIATIONS USED IN THE TABLES

HA — High Aluminia

HG — High Grog

PL — Plastic

B — Basic

CB — Chemically Bonded

CO — Coke Oven

OT — Other than Coke Oven.

Demand, availability and surplus/deficit during 1971—85 *of* **FIRECLAY AND HIGH ALUMINA BRICKS**

Year/Type	1971			1972		
	HA & HG	LG	PL	HA & HG	LG	PL
Demand	6·9 53·2	100·4	146·5	15·4 68·6	123·1	165·2
	60·1			84·0		
Availability	95·8	115·4	186·4	131·4	125·5	191·2
Availability to steel industry	71·8	86·5	150	98·6	94·3	153·7
Surplus	11·7		3·5	14·6		
Deficit		13·9			28·8	11·6

Year/Type	1973			1974		
	HA & HG	LG	PL	HA & HG	LG	PL
Demand	19·2 78·0	114·2	171·8	33·3 92·2	165·7	184·9
	97·2			125·5		
Availability	175·1	135·6	196·1	206·6	138·4	197·6
Availability to steel industry	131·2	101·8	156·5	154·9	103·8	158·2
Surplus	34·0			29·4		
Deficit		12·4	15·3		61·9	26·7

Year/Type	1975			1976		
	HA & HG	LG	PL	HA & HG	LG	PL
Demand	31·7 108·9	182·0	179·6	34·9 126·5	194·6	178·3
	140·6			161·4		
Availability	282·4	149	202·1	298·2	151·2	203
Availability to steel industry	211·8	111·7	161·9	223·6	113·4	162·3
Surplus	71·2			62·2		
Deficit		70·3	17·7		81·2	16·0

Year/Type	1977			1978		
	HA & HG	LG	PL	HA & HG	LG	PL
Demand	38·7 190·6	208·7	178·2	43·1 234·7	235·7	180.2
	229·3			277·8		
Availability	304	153·6	203·8	304	153·6	203·8
Availability to steel industry	228	115·2	162·9	228	115·2	162·9
Surplus	1·3					
Deficit		93·5	15·3	49·8	120·5	17·3

NOTES :

1. Availability to steel industry was assumed at 75% of total availability of refractories from the 14 refractory units considered.
2. In the case of refractories by the plastic process an additional 10,000 tonnes representing availability from units other than the 14 studied, has been included.

Demand, availability & surplus/deficit during 1971—85 *of* **FIRECLAY AND HIGH ALUMINA BRICKS**

Year/Type	1979			1980		
	HA & HG	LG	PL	HA & HG	LG	PL
Demand	48·0 288·0 336·0	260·9	187·1	47·4 344·7 392·1	263·2	186
Availability	304	153·6	203·8	309	153·6	203·8
Availability to steel industry	228	115·2	162·9	228	115·2	162·9
Surplus						
Deficit	108·0	145·7	24·2	164·1	148·0	23·1

Year/Type	1981			1982		
	HA & HG	LG	PL	HA & HG	LG	PL
Demand	49·2 393·3 442·5	276·7	190·9	51·6 452·7 504·3	296·2	195·2
Availability	304	153·6	203·8	304	153·6	203·8
Availability to steel industry	228	115·2	162·9	228	115·2	162·9
Surplus						
Deficit	214·5	161·5	28·0	276·3	181·0	32·3

Year/Type	1983			1984		
	HA & HG	LG	PL	HA & HG	LG	PL
Demand	53·2 507·1 560·3	307·4	199·2	54·8 551·5 606·3	318·6	203·2
Availability	304	153·6	203·8	304	153·6	203·8
Availability to steel industry	228	115·2	162·9	228	115·2	169·8
Surplus						
Deficit	332·3	192·2	36·3	378·3	203·4	33·4

Year/Type	1985		
	HA & HG	LG	PL
Demand	55·4 594·9 655·3	329·8	207·2
Availability	304	153·6	203·8
Availability to steel industry	228	115·2	169·8
Surplus			
Deficit	427·3	214·6	37·4

NOTES :

1. Availability to steel industry was assumed at 75% of total availability of refractories from the 14 refractory units considered.
2. In the case of refractories by the plastic process an additional 10,000 tonnes representing availability from units other than the 14 studied, has been included.

Demand Availability Surplus/deficit of **BASIC REFRACTORIES** *during* 1971 *to* 1985 *for the steel industry*

Year/Type	1971		1972		1973		1974	
	B	CB	B	CB	B	CB	B	CB
Demand	71·1	36·5	80·3	39·2	84·6	41·6	90·9	43·3
Availability	58·6	48·0	66·1	48·0	73·6	54·0	78·6	64·5
Availability to Steel Industry	55·6	45·6	62·8	45·6	69·9	51·3	74·7	61·3
Surplus		9·1		6·2		9·7		18
Deficit	16		17·5		14·5		17·2	

Year/Type	1975		1976		1977		1978	
	B	CB	B	CB	B	CB	B	CB
Demand	99·1	42·8	96·9	41·8	104·2	41·3	113·1	41·3
Availability	131·4	66·25	145·2	90·9	149	91·6	149	91·6
Availability to Steel Industry	124·8	62·7	138	86·3	141·5	80·6	141·5	87
Surplus	25·7	19·9	41·9	44·4	37·3	45·7	28·4	45·7
Deficit								

Year/Type	1979		1980		1981		1982		Remarks
	B	CB	B	CB	B	CB	B	CB	
Demand	123·3	41·3	133·2	41·3	139·3	41·3	152·9	41·3	
Availability	149	91·6	149	91·6	149	91·6	149	91·6	
Availability to Steel Industry	141·5	87	141.5	87	141·5	87	141·5	87	
Surplus	18·2	45·7	8·3	45·7	2·2	45·7		45·7	
Deficit							11·4		

Year/Type	1983		1984		1985		Remarks
	B	CB	B	CB	B	CB	
Demand	159·7	41·3	166·8	41·3	172·3	41·3	
Availability	149	91·6	149	91·6	149	91·6	
Availability to Steel Industry	141·5	87	141·5	87	141·5	87	
Surplus		45·7		45·7		45·7	
Deficit	18·2		25·3		30·8		

NOTE :

Availability of Basic Refractories to Steel Industry has been assumed at 95% of the total availability.

Demand, availability, surplus/deficit of **DEAD BURNT MAGNESITE** *during* 1971 to 1985

Year	1971	1972	1973	1974
Demand	120·50	139·40	147·10	155·5
Availability	78·00	106·00	131·00	142·0
Deficit	42·50	33·40	16·10	13·50
Surplus	..	..	..	..

Year	1975	1976	1977
Demand	162·70	159·70	165·00
Availability	144·00	144·00	144·00
Deficit	18·70	15·70	21·00
Surplus	..	..	..

Year	1978	1979	1980	1981	1982
Demand	171·90	170·9	187·6	192·4	203·0
Availability	141·00	144·0	144·0	144·0	144·0
Deficit	30·9	35·9	43·6	48·4	59·0
Surplus	..	..	..	..	..

Year	1983	1984	1985
Demand	208·4	213·8	218·1
Availability	144·0	144·0	144·0
Deficit	64·4	69·8	74·1
Surplus	..	..	..

Demand/availability surplus/deficit of
SILICA BRICKS *during* 1971 *to* 1985 *for Steel Industry*

	1971		1972		1973		1974	
	CO	OT	CO	OT	CO	OT	CO	OT
Demand	13·1	51·16	39·8	62·54	20·8	63·51	67·6	56·86
Availability	17·4	46·5	25·6	46·4	39·1	46·3	39·6	46·3
Availability to steel industry	17·4	41·8	25·6	41·8	39·1	41·8	39·6	41·8
Surplus	4·3				18·3			
Deficit		8·5	14·2	20·7		21·7	28·0	15·0

	1975		1976		1977	
	CO	OT	CO	OT	CO	OT
Demand	82·3	54·81	55·9	46·46	54·3	46·41
Availability	52·5	55·2	53·7	55·3	54·9	55·6
Availability to steel industry	52·5	50·0	53·7	50·0	54·9	50·0
Surplus				3·6	0·6	3·6
Deficit	29·8	4·31	2·2			

	1978		1979		1980		1981	
	CO	OT	CO	OT	CO	OT	CO	OT
Demand	53·3	48·51	60·43	50·61	47·15	52·81	47·25	55·01
Availability	54·9	55·6	54·9	55·6	54·9	55·6	54·9	55·6
Availability to steel industry	54·9	50	54·9	50	54·9	50	54·9	50
Surplus		1·5					7·7	
Deficit	1·6		5·5	0·61	9·5	2·81		5·0

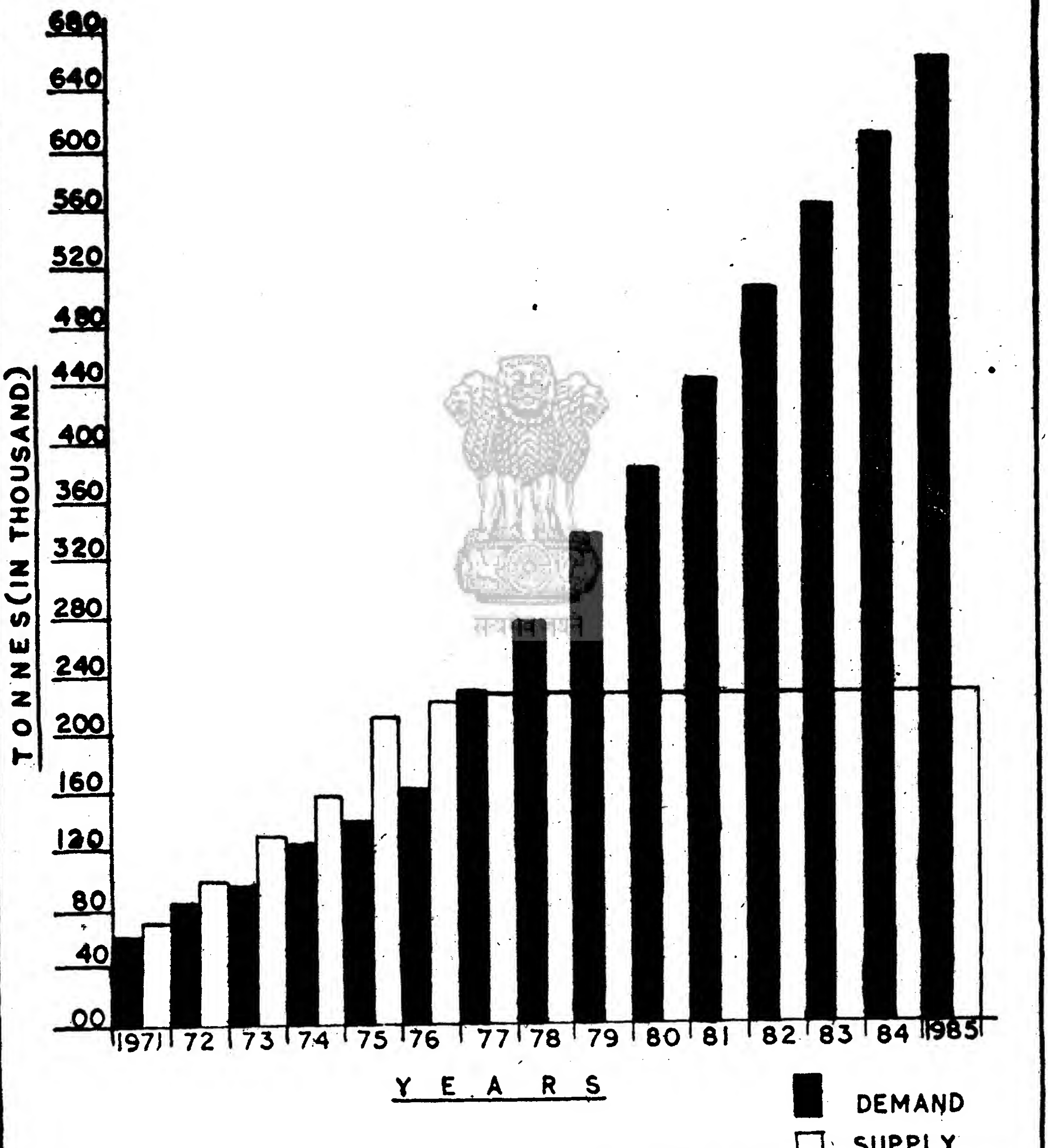
	1982		1983		1984		1985	
	CO	OT	CO	OT	CO	OT	CO	OT
Demand	47·35	57·21	47·35	49·41	44·05	61·61	44·15	63·81
Availability	54·9	55·6	54·9	55·6	54·9	55·6	54·9	55·6
Availability to steel industry	54·9	50	54·9	50	54·9	50	54·9	50
Surplus	7·6		7·6		10·9		11·8	
Deficit		7·21		9·41		11·61		13·81

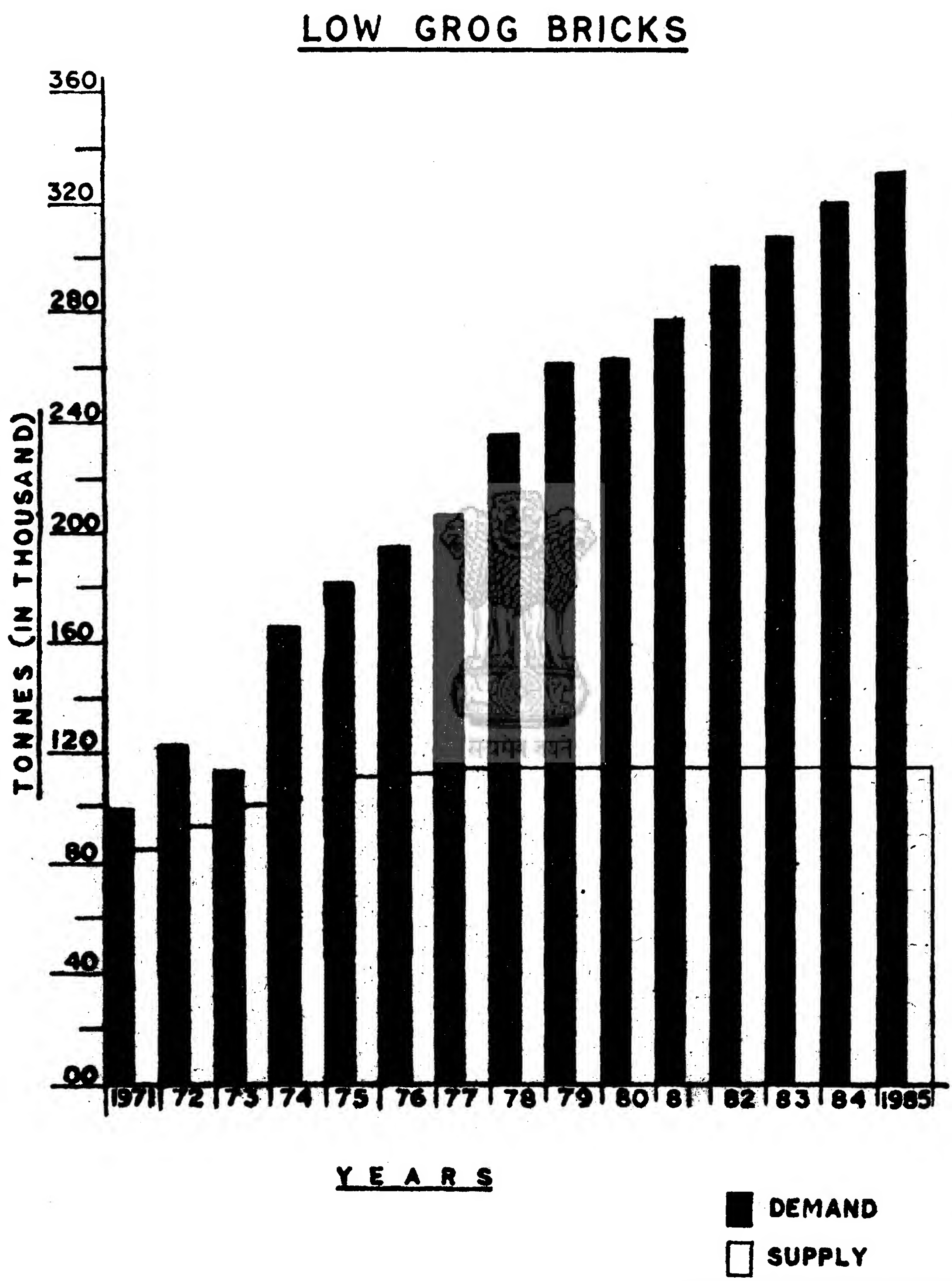
NOTES :

1. 100% availability of Coke Oven Silica refractories to steel industry has been assumed.
2. 90% availability of Silica Bricks (other than Coke Ovens) has been assumed for steel industry.

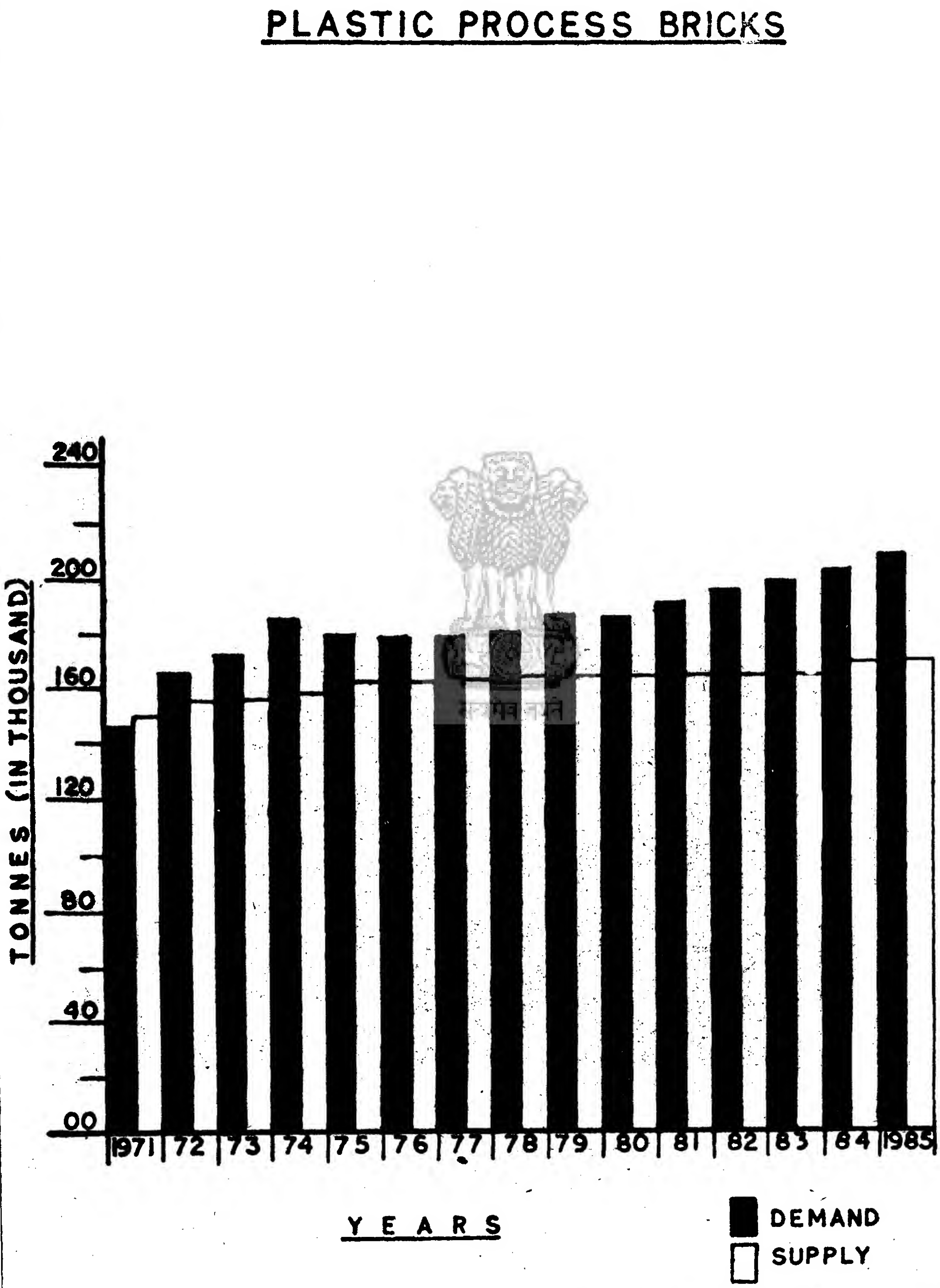
GRAPHS

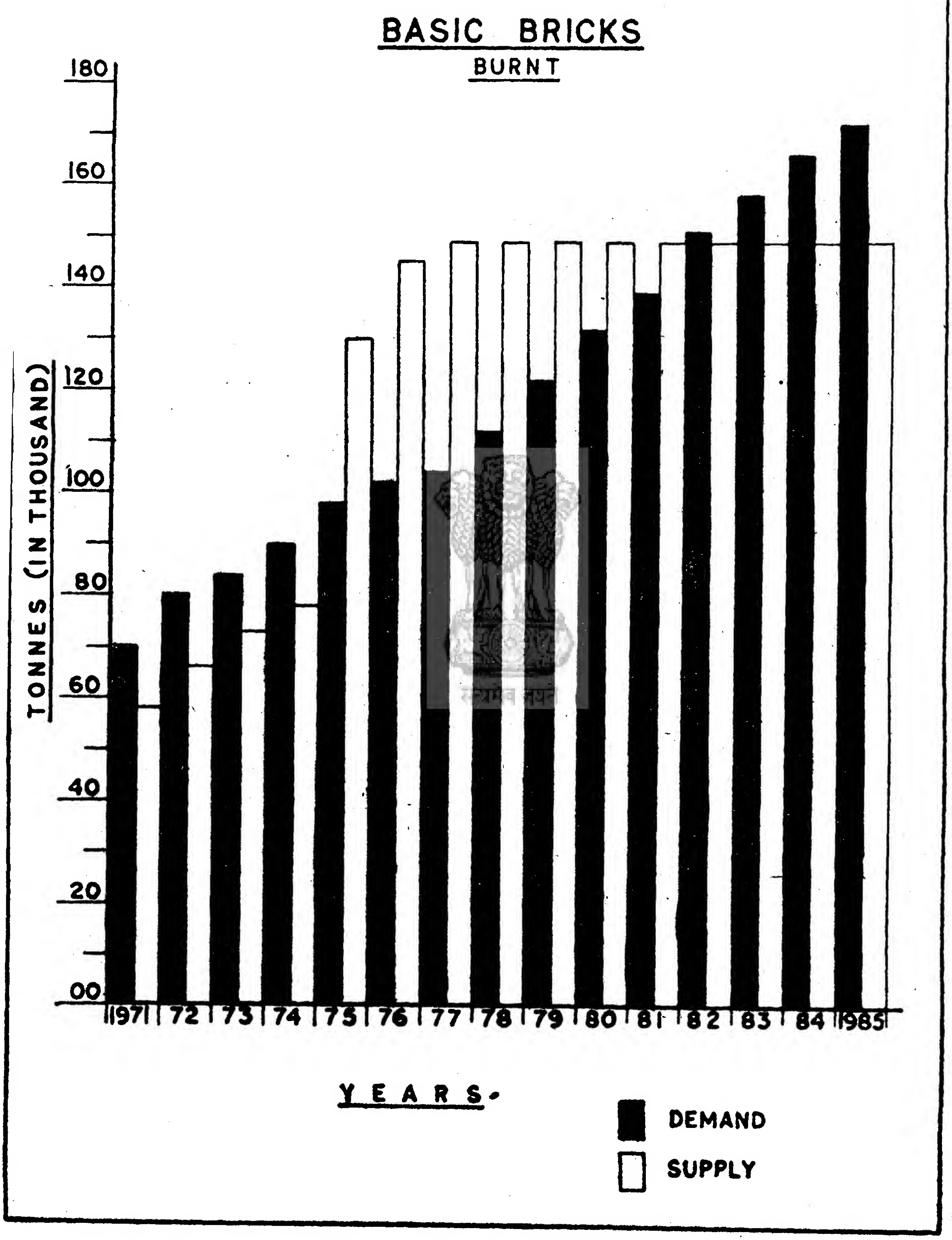
HIGH GROG AND HIGH ALUMINA BRICKS





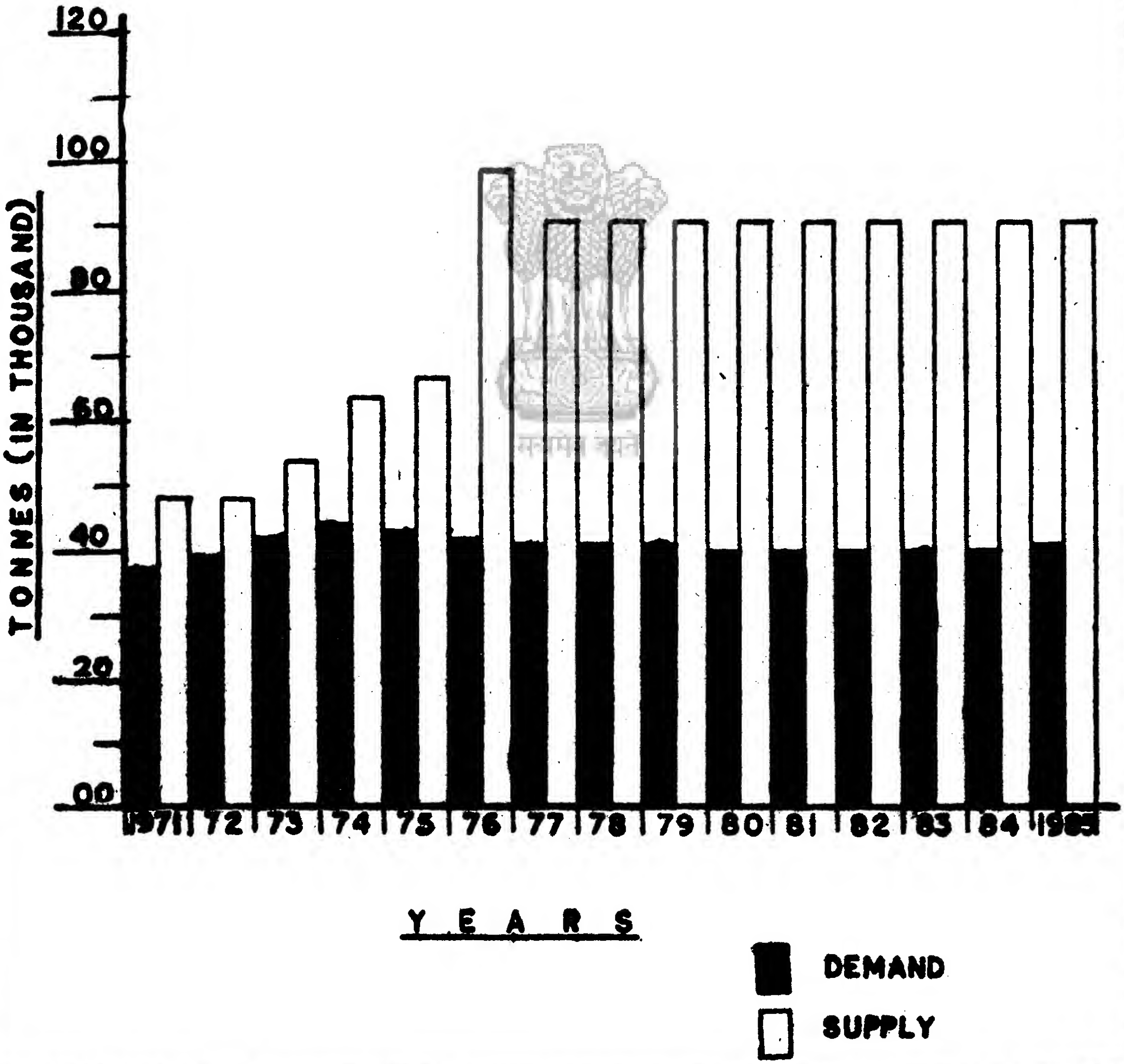
LOW GROG BRICKS
360
320
280
240
200
160
120
80
40
00
TONNES (IN THOUSAND)
1971
72
73
74
75
76
77
78
79
80
81
82
83
84
1985
YEARS
DEMAND
SUPPLY

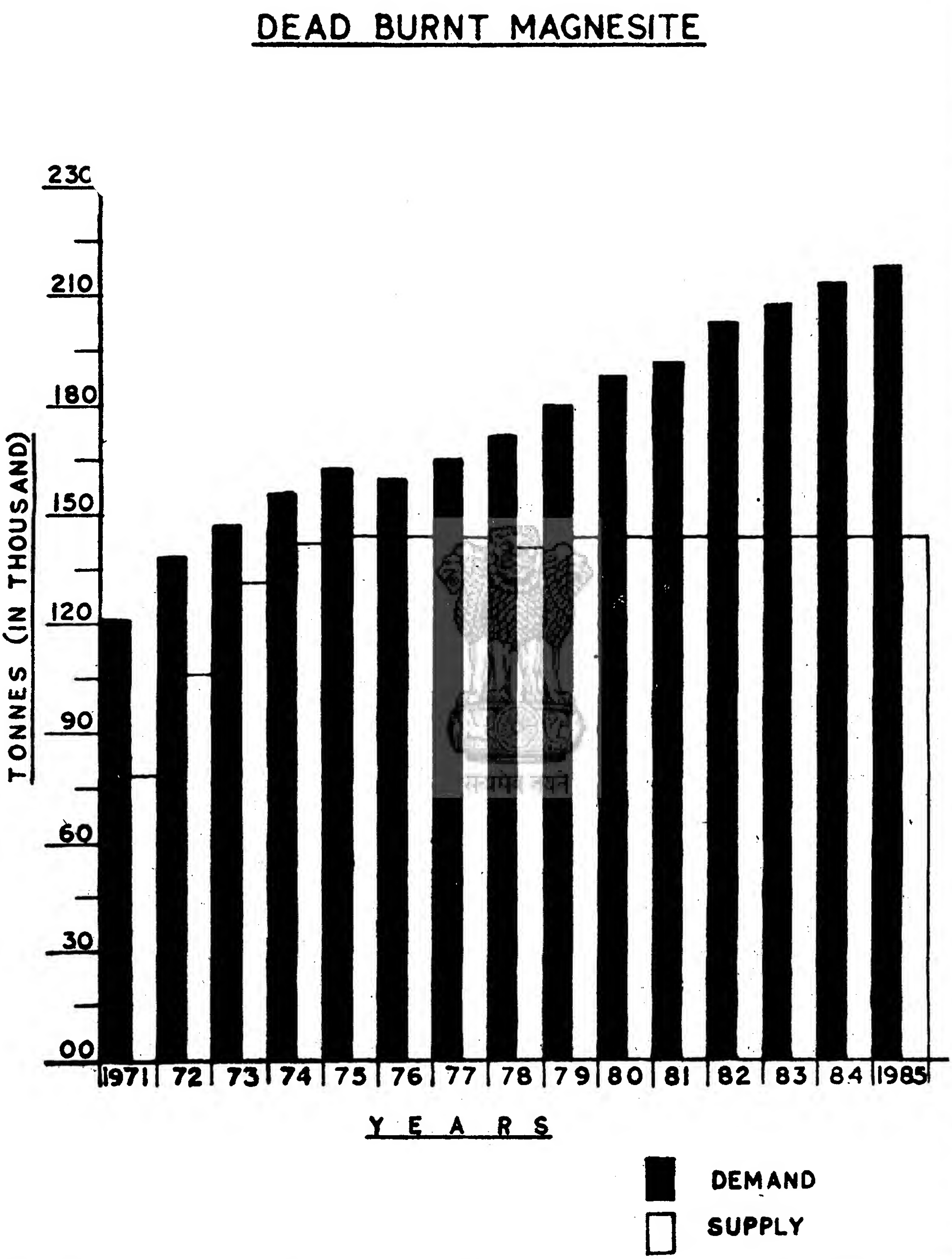

PLASTIC PROCESS BRICKS
240
200
160
120
80
40
00
TONNES (IN THOUSAND)
1971
72
73
74
75
76
77
78
79
80
81
82
83
84
1985
YEARS
DEMAND
SUPPLY

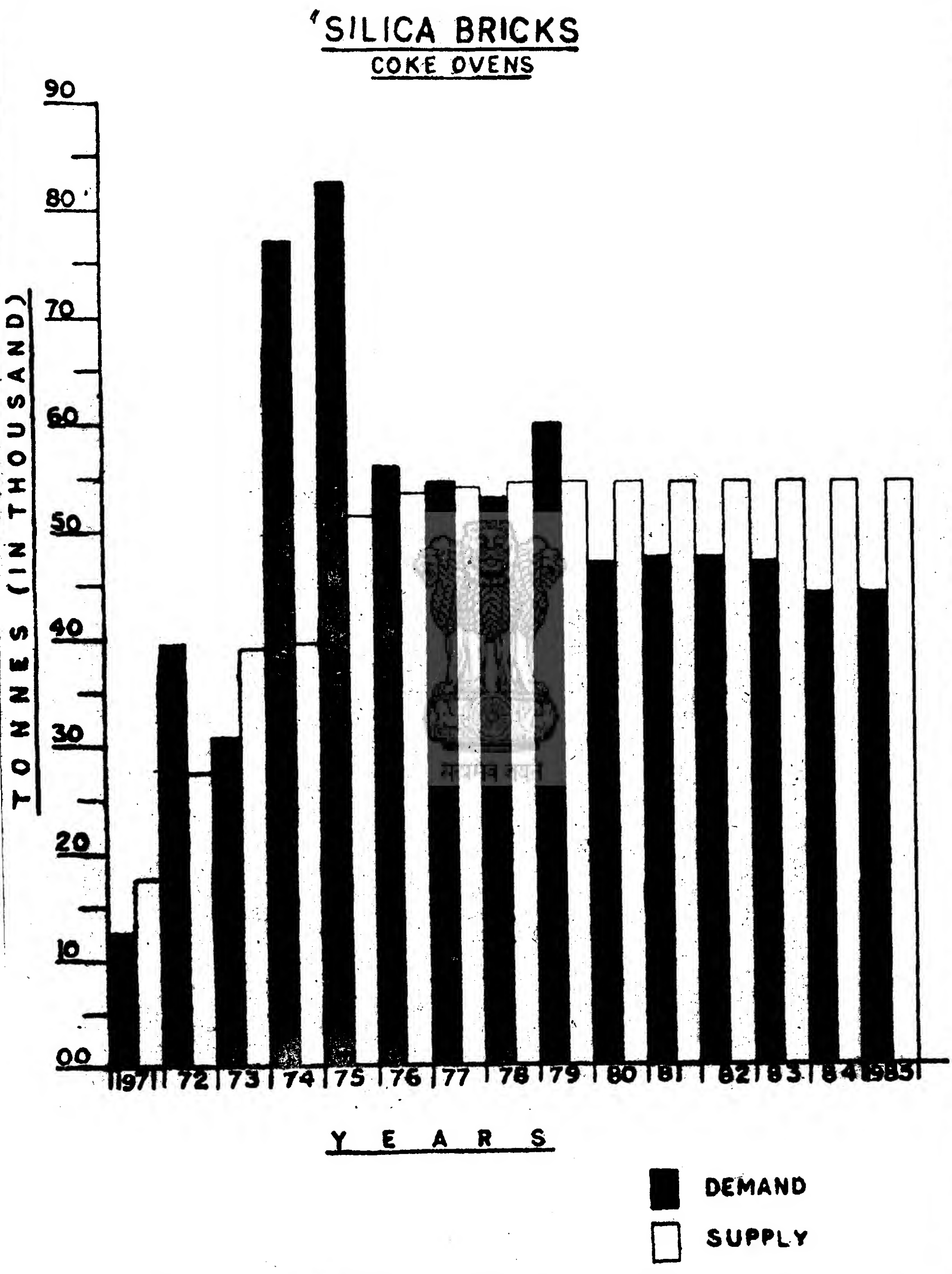


BASIC BRICKS
BURNT
TONNES (IN THOUSAND)
180
160
140
120
100
80
60
40
20
00
1971
72
73
74
75
76
77
78
79
80
81
82
83
84
1985
YEARS.
DEMAND
SUPPLY

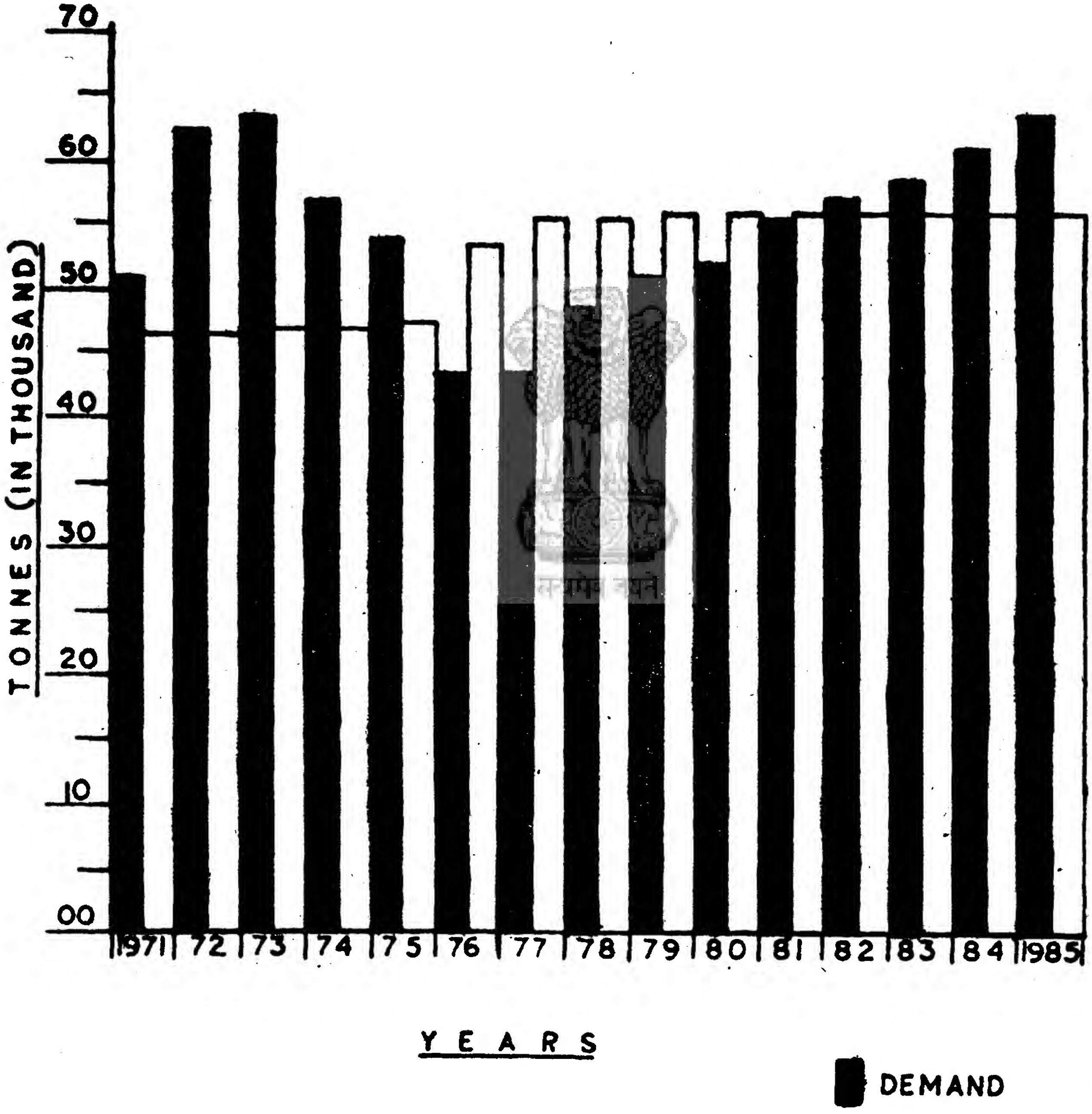
BASIC BRICKS
CHEMICALLY BONDED




DEAD BURNT MAGNESITE
TONNES (IN THOUSAND)
230
210
180
150
120
90
60
30
00
1971
72
73
74
75
76
77
78
79
80
81
82
83
84
1985
YEARS
DEMAND
SUPPLY


SILICA BRICKS
COKE OVENS
TONNES (IN THOUSAND)
90
80
70
60
50
40
30
20
10
00
1971
72
73
74
75
76
77
78
79
80
81
82
83
84
1985
YEARS
DEMAND
SUPPLY

SILICA BRICKS
OTHERS



CHAPTER 7

STEPS TO BRIDGE THE GAP

1. High grog variety of fireclay bricks

There would appear to be no immediate necessity to consider additional capacity. However, to take care of the deficit after 1977, it would be necessary to plan substantial increase in capacity for production of this quality. Such capacity could be set up at the rate of 50,000 tonnes per year with a phasing suited to the steel development programme. Such plants could have linkage with the new steel plants and located after taking into consideration availability of raw material.

2. Low grog variety of fireclay bricks

The surplus in high grog variety could be diverted to take care of the deficit in the availability of this quality upto 1973. For the period thereafter it would be necessary to plan for additional capacity. An annual increase in capacity at the rate of 20,000 tonnes should be planned.

3. Plastic

There is a deficit for the refractories by the plastic process from 1972 onwards. There are a number of small units manufacturing bricks by the plastic process. Their products are, however, not suitable to the steel plants requirements due to inferior quality. These units may be encouraged to take such steps as setting up of appropriate presses, quality control equipment, etc., as would improve their quality so that they are acceptable to the steel plants.

4. Basic Refractories (Burnt)

Import of burnt basic refractories upto 1974 would appear inescapable. The actual quantities to be imported should take into account steel making capacity reachedi n the plants, the dead burning capacity available and the inventories which the steel plants may be having of basic bricks imported in the past years and not consumed. Wherever possible, requirement of Burnt bricks may be substituted by Chemically. Bonded Bricks. Beyond 1975, the increase in capacity proposed would appear to be far too sharp. This increase in capacity could be progressive over the period 1975 to 1982, suited to the steel plants' requirements.

4·1. The public sector refractory plant proposed to be set up at Bhilai is essentially captive to the requirements of Bhilai for fireclay and basic refractories. Out of a total requirement of about 49,000 tonnes basic bricks, the plant is to supply 30,000 tonnes of bricks. In view of this position, it is essential that the public sector refractory plant reaches rated capacity operation for basic bricks as soon as possible. The industry particularly Orissa Industries which has a letter of intent for setting up a capacity of 50,000 tonnes of basic refractories and Mysore Industrial Development Corpn., which is contemplating to include substantial quantity of basic refractories in its proposed refractory plant with a capacity of 130,000 tonnes for which it has recently received a letter of intent, could modify or re-adjust their productmix and have appropriate plans for diversification.

4·2. To take care of the deficit which is likely to arise after 1982, it will be necessary to plan for additional capacity by 1978. Or alternatively, the surplus capacity for chemically bonded capacity could be suitably modified to make available additional burnt magnesite refractories.

5. Chemically bonded

There is a surplus of chemically bonded capacity and this surplus is likely to increase if all the licensees carry out their programmes as anticipated. It would also not be possible to consider diverting chemically bonded capacity to burnt bricks for the following reasons:

(i) Such conversion is not feasible unless additional facilities are put in.

(ii) Even on burnt bricks, there is likely to be a surplus beyond 1974.

5·1. It is, therefore, suggested that there should be no increase in capacity for chemically bonded bricks and any expansion proposals on hand should be dropped.

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5·2. *Dead Burnt Magnesite :* Additional burning capacity would have to be planned immediately so that it becomes available by 1975. The Public Sector Refractory Plant, could therefore, plan for a captive burning capacity. It would also be necessary to stop exports of lightly calcined magnesite. In 1970, 33,500 tonnes of this material were exported and the realisation was about Rs. 1 crore. In the period 1970-71, approximately 30,000 tonnes of Dead Burnt magnesite was imported at a c.i.f. cost of Rs. 1·80 crores. Since imports have continued almost at the same level in 1971-72 also, it is in the national interest to set up burning capacity to utilise the magnesite rather than export lightly calcined variety quite cheaply and import the expensive Dead Burnt Magnesite.

6. Silica (coke ovens)

6·1. The immediate deficit would require to be met through imports. The deficit likely to arise in 1972 can be taken care of by advancing some of the 1973 requirements since 1973 would appear to be a surplus year for this item.

6·2. A spurt in demand would develop in 1974 and 1975; unless new capacity can be made available to take care of this demand, it would seem that this demand would also have to be met through imports. Deficits are likely to occur once again in 1979 and 1980. The peak demands of1974 and 1975 may repeat periodically after every 15 years for rebuilding work of existing batteries. Further, IISCO batteries may require building which has not been taken into account and it is also possible that additional coking capacity may be set up at Burnpur. Further, in the projections of demand, requirements of coke oven bricks for the batteries of the steel plants have only been taken into account. There are other coke ovens in operation outside the steel sector (for example, the batteries of Durgapur Projects Ltd., the Sindri Fertilizers, etc.) equivalent to about 20% of the ovens existing in steel plants. If their requirements for rebuild, repair are also taken into account, there would appear to be need to provide additional capacity for coke oven silica bricks. Such capacity is likely to remain under-utilised periodically depending on fluctuations of coke oven silica demand and would, therefore, have to be with an unit which has manufacturing facilities for other qualities of bricks also. During the periods of slump in domestic demand, there is a possibility of export of coke oven silica shapes. It may be relevant to mention that West Germany has such inbuilt capacity for production of coke oven silica shapes. As a result today, countries like Czechoslovakia considered to be one of the traditional suppliers of coke oven silica bricks are themselves importing from West Germany to take care of their constructional programmes.

6·3. It is, therefore, recommended that the proposed public sector refractory plant at Bhilai consider increasing their capacity for silica bricks from 10,000 tonnes to 20,000 tonnes. To avoid large scale imports in 1974 and 1975, it is essential that such capacity should be set up urgently so that it becomes available by 1974. The Committee, however, felt that it may be extremely difficult for new capacity at Bhilai to be set up so expeditiously as to give the benefit of nearly full production in 1974 and 1975. In the alternative it would, therefore, be recommended that in case some of the existing producers in the private sector could expand their capacity for coke oven silica bricks within the next 2 years, they may be encouraged to do so. Wherever, the capacity is ultimately set up, it is of utmost importance for steel industry to plan coke oven silica requirements on a longterm basis so that it would avoid sudden spurts of demand. This pre-planning is of utmost importance since the requirements of one battery or in some cases, a part battery should necessarily be met from one source of supply.

7. Other than coke oven silica

7·1. There is a deficit of this quality upto 1975 and imports would appear to be the only solution. It could, however, be considered whether a large quantum of silica bricks for other than coke ovens be imported and the domestic capacity thus becoming available, diverted for production of coke oven shapes. This is likely to be more cost beneficial since import of silica bricks for other than coke oven is likely to be cheaper and the bricks might also become available more easily since the majority of these would be standard bricks. A surplus would be available for these bricks from 1976 upto 1978 and thereafter, there would be a progressive increasing deficit. With pre-planning and bringing forward some of the constructional demands to the period of surplus, it would be possible to have a more balance demand and availability for this quality. Further, the latent capacity to be planned for coke oven silica could be diverted for production of other than coke oven silica refractories when such need arises.

CHAPTER 8

GENERAL RECOMMENDATIONS

FIRECLAY REFRACTORIES

The general experience of the public sector steel plants has been when tenders are invited, the response from the refractory industry is not satisfactory. In a recent tender of the Rourkela Steel Plant for 21,000 tonnes of refractories needed by the stiff plastic process for blast furnace stoves, only one or two firms had responded. Even in this case, the delivery indicated was protracted.

2. On a detailed analysis, it was found that the public sector tendering procedure is one of the contributory factors for non-availability of offers for fireclay refractories. When the private sector plants purchase refractories, an agreement is reached between the buyers and sellers so that the latter get a mix of the difficult and less difficult items of refractories, the difficult ones being extruded items and hand moulded refractories involving large variety of shapes in small quantities which lower down the production of the refractory unit. Whereas, when the public sector plants call for tenders, the tendency for the refractory industry is to quote for the relatively easier items leaving out the more difficult ones for which the steel plants seek imports.

3. It has also been found that the capacity available for firebricks is not balanced. When bricks are to be manufactured by extruding process requiring large space for drying in shade and suitable firing facilities, the situation today in the refractory industry is such that where extrusion facilities exist, the other facilities of space, shade or firing are not available or where the latter facilities exist, extrusion press is not available.

4. Further, where requirements are of hand moulded bricks and substantial investment in moulds and extra space is required for such manufacture the refractory industry is not willing to commit itself to the additional expenditure in the absence of a firm indication from the steel plants that they would load their capacity on a continuing basis. If a system coluld be devised whereby long-term commitments can be entered for such difficult items, it was found that the refractory industry was willing to incur such an expenditure and supplies to steel plants could be ensured on a more regular and sustained basis.

5. Another reason for lack of adequate supplies of fireclay refractories has been the problem of specification including varying specifications. The Sub-Committee on Standardisation is already seized of this problem and acceptance of their recommendations would go a long way in resolving this problem.

6. Generally, of the fireclay refractories, the following items are found to be difficult to obtain within the country and as such, imports may become necessary until the capacity within the country is balanced. These are—

(i) Hollow warelike, pouring refractories, stoppers, well blocks, bloating nozzles, sleeves bottom pouring refractories and Brassert checkers.

(ii) Hand moulded refractories.

(iii) Soaking pit refractories.

(iv) Recuperator tubes, high alumina hearth bricks for reheating furnaces.

7. It is suggested that wherever possible, the steel plants should consider a switch from Brassert checkers to Mckee checkers which are more easily available. It is, however, agreed that such a conversion may not be possible immediately and could be carried out over a long period only. It is suggested that the public sector plant should take note of these shortages and include the items in these product-mix. Further, while granting new letters of intent, the Ministry of Industrial Development should insist upon inclusion of these difficult items in their product mix. Even where letters of intent have already been granted, this could be pursued by the Ministry of ID&IT.

8. For soaking pit cover refractories, it is recommended that there should be a progressive change over to the Monolothic refractories. The use of monolothic refractories would

replace bricks of various shapes and sizes required on the soaking pit covers. It would also facilitate hot repairs to be effected. It has been found that the life of covers had increased considerably with use of monolithic refractories.

9. For stoppers and nozzles, it was found that the CGCRI had synthesised a bloating clay and a sample is being prepared for trials at Alloy Steels Plant, Durgapur. With wider acceptance of continuous casting technology, there would be increasing demand for quality Zircon nozzles. Certain developmental work has been carried out in the country by NML, CGCRI, Belpahar Refractories and Mukand Iron & Steel Works. Further work in this direction is necessary to bring up the production of these refractories both in quantitative and qualitative terms. Development of bloating clays should be vigorously pursued and the Japanese example of usage of bloating clays for manufacture of ladle refractories should be considered because of their better performance.

10. It has been agreed that after the steel plants call for annual tenders for their requirements of refractories and thus come up against items for which there are no suitable offers, a list of such items be sent to the DGTD for their examination. The DGTD would then consult with the Indian Refractories Makers' Association. On the basis of such a discussion, a meeting is to be held under the Steel Ministry to come to an understanding if any of these items require import. This could be an annual exercise to be carried out between January and February of every year. It was also agreed that this meeting could be a proper forum to discuss backlog of orders with the indigenous manufacturers and for taking corrective action.

BASIC REFRACTORIES

11. In the detailed discussions which the Expert Group had with Steel Plants, only Durgapur Steel Plant mentioned that they had some difficulty in getting basic bricks. On examination, it was found that the difficulty was due to the unwieldly size of magnesite bricks for lining of inactive mixers, (individual weights of bricks being 40-70 Kg.) and the difficulty in obtaining Detrick shapes for the Open Hearth Uptakes. On examination, it was found that it would be possible to obtain the Detrick shapes within the country. For the mixers, it is recommended an alternative lining design be employed which would not require such heavy bricks and which are being used by Bhilai. It is suggested Durgapur Steel Plant pursue this matter on these lines and come to a satisfactory solution.

12. In the context of attaining self-sufficiency in refractories, it is emphasized that steel plants should vigorously take up work of alteration to lining design if such alteration enables them to obtain the requirement of refractories, within the country without affecting their production.

SILICA REFRACTORIES

13. In so far as silica refractories are concerned, in 1971, there ought to have been a surplus capacity of coke oven silica bricks and a shortfall for other than coke oven silica refractories. Since capacities for production of coke oven silica and other than coke oven silica are interchangeable, it is likely that a part of the coke oven silica capacity got diverted for meeting the other than coke oven silica demand.

14. From the statement, it would be seen that the coke oven silica bricks demand is periodical and fluctuates considerably . It is, therefore, considered desirable for the steel plants to carry at any time an inventory of bricks required for rebuilding of one battery or in the alternative, at least, the requirements of special shapes and sizes for a battery which are difficult to obtain within a short- time may be carried on stock.

15. To take care of fluctuations in demand and to utilise capacity better, it would be necessary for the steel plants to book coke oven silica capacity on a long-term basis at least for the next 3/5 years. This could be done on a revolving basis, i.e., after an year, is over another year's requirements can be added so that always there is a 3 year plan of ordering. Two batteries at Durgapur Steel Plant, 3 batteries at Rourkela, three batteries, at Bhilai and three batteries at Durgapur are in an unsatisfactory condition and it should be possible to programme their rebuilding more precisely. If long-term orders can be placed on manufacturers they will try to preserve the moulds. Otherwise, the capital blocked and cost of storage coupled with the uncertainty of future orders may not encourage the manufacturers firstly to invest in the moulds and secondly to stock the moulds. With the number and variety of coke oven shapes timely availability of moulds plays an important role in ensuring supply of bricks when wanted.

16. Further, the rebuilding requirements of coke oven battery should normally come from one source of supply. In the case of all batteries in operation in the country, except the Bhilai batteries, the battery is composed of two half sections. It was agreed that in such cases, it was sufficient if requirements of one section, i.e., half battery were obtained from one source. It was also found that except in case of Indian Firebricks and Insulation Co. who are planning a capacity of 9,000 tonnes coke oven silica by mid 1973 there is no other source of additional availability for silica bricks.

Problems of Electric Furnaces

17. Due to the variety of design and electric are furnaces of varying sizes set up over a long period in the past, it was found that the refractory manufacturers find it difficult to meet the requirement. The furnaces of the future would be generally of the 10/20 T capacity which is likely to result in standardisation of refractories needed by them. A measure of standardisation for other furnaces with a rammed mass in the centre of the roof and only a few sizes with radial concentric lining was also distinctly possible. It would facilitate a number of manufacturers to supply the requirement.

18. Similarly, the basic wall bricks as well as ladle lining require to be standardised. These aspects have already been taken up for investigation by the Steel Furnace Association in consultation with the IRMA. This would also be looked into by the Standardisation Sub-Committee. Indian Refractory Makers' Association Vice-President, Dr. Ghose, offered his assistance since a considerable work in this direction has been put in by Belpahar and several of the electric furnace users who are their clients are already using such shapes to their advantage.

19. The problems experienced in obtaining stopper heads could be overcome to a certain extent by usage of Fireclay stopper heads wherever possible. For clay graphite stoppers, availability of raw material is a bottleneck and import of raw material has to be allowed as required.

20. As in the case of the main steel plants, the problems could be overcome by periodical discussions between the Steel Furnace Association of India and Indian Refractory Makers' Association with the assistance of the DGTD and the Department of Steel.

MISCELLANEOUS:

21. As a result of the work of this Committee, it has been possible to bring together the main consumers and the producers of refractories in the country to appreciate more fully each others difficulties and point of view. A large amount of useful data about availability and demand of refractories has also been compiled. Due to non-availability of some data and lack of coordination at any one point of reference, in the past, shortages both in terms of quantity and quality had occurred resulting in large scale import of refractories. It is, therefore, a suggested that the demand and availability projections obtained in this Report be subjected to a review. The Refractories Panel where both producers, steel plants, research bodies and the Government are represented, was considered the best forum for carrying out this exercise on an annual basis. At least, one meeting of the Panel every year should devote itself to this analysis and the projections brought up-to-date.

22. The problems of technological nature and import substitution should be referred to the Refractories Panel. It is learnt that the panel would be setting up a Specialist group which would study these problems and report back to the Panel.

23. To produce refractories to the quality stipulations of steel industry, every manufacturer should have minimum testing facilities. The Indian Refractory Makers' Association shall make this assessment listing out member units and giving detailed list of equipment required for each unit. The DGTD should take steps to ensure that plants in the organised sector are equippeed for this purpose.

24. The Central Glass & Ceramic Research Institute should provide the necessary testing wherever required to the industry. Testing of Refractories is included as one of the objectives of this Institute since its inception as this is the only statutory laboratory recognised by the Government of India, including Defence, for this purpose. The available equipment and personnel can handle about 400 samples in a year. Out of these samples, on an average 80 are received from steel plants, 160 are sent by the refractory manufacturers and other consumers of refractories, 160 are for internal investigations in progress at the Institute. It may be pointed out that Bokaro Steel Ltd. got almost all their refractory samples tested at this

Institute at the beginning of their constructional programme and the same is expected to be repeated by all new steel plants. The quantum of such work is expected to be of the order of 80 samples per year per steel plant of 2 million tonne capacity. In addition, the quantum of work for the petroleum industry, is expected to increase considerably.

25. The present testing facilities at the Institute are inadequate to cope with the increasing work load and requirements of the new steel plants proposed to be set up in the country in the 5th and 6th Five Year Plans. The petrochemical industries are also growing and the refractories required by them will also have to be tested by this Institute.

26. Under these circumstances, it is desirable to augment the testing facilities at Central Glass & Ceramic Research Institute from the present of 400 samples per year to at least 600 samples annually. On a rough estimate, the financial provision required for executing the project is likely to be as follows:

(i) Capital Rs. 4.5 lakhs

(ii) Recurring Rs. 1.0 lakh per year

While this may provide a short term solution, looking further ahead for an independent Institute for refractories would be worth considering. The Refractory Industry today has a turn over of Rs. 40 crores annually. Refractories are one of the essential inputs for the steel industry. Considering the large steel development programme envisaged by the country and rapid structural changes in steel technology requiring ever more stringent performance requirement from refractories, it would appear desirable to have a Refractories Research Institute as a separate entity. A combined Research Institute for refractories glass ceramics, enamels and potteries may not provide the right emphasis required for research and development of refractories suited to the local conditions and materials.

27. Import of steel required for manufacture of moulds by the Refractory makers should be allowed if the indigenous manufacturers are not able to supply the requirements.

28. In priority allocation of steel, requirements of steel for cladding of bricks required by steel plants should receive the same priority as the direct steel requirements of steel plants.

CHAPTER 9

TRENDS FOR FUTURE

1. It is of utmost importance that the growth of the refractory industry is closely linked with that of the steel industry. There is a constant effort on the part of the steel industry to adopt changing trends in modern technology so that the steel making costs come down. This is of very great importance to the integrated steel plants which are highly capital intensive. It would be seen that in all principal steel making countries, such coordinated growth had taken place.

2. In the case of the coke ovens, the trend is now to have taller ovens (6 metre and above) with faster coking rates whereby the output is almost doubled compared to the present ovens. This would need super duty silica bricks. In the case of blast furnaces, technological improvements like high temperature operation, higher blast temperatures, fuel injection, blast enrichment with oxygen along with larger sized furnaces are employed to increase the production. This would require a switch to the use of high alumina bricks. The steel making technology in open hearth furnaces has already changed and silica roofs are replaced by basic roofs and oxygen introduced to reduce the tap to tap time. The furnace size has also increased considerably and Bhilai now uses 500 tonne open hearth furnaces. The steel making practice in tonnage steel plants has completely altered with the introduction of the Basic Oxygen Convertor. While in the initial stages these converters were using tar Dolomite bricks for their lining, the trend now is to use tar impregnated magnesite lining. Further, there is a constant effort to improve the lining life of convertors which could mean a reduction in the levels of consumption of refractories. The soaking zones of reheating furnaces now use electrocast refractories with considerably increased life. These refractories are made by multi blends of magnesia and casting them in brick shapes. Bloating clays are being synthesised to produce the right quality teeming refractiories including ladle bricks. In integrated steel plants nearly 2/3rds of the capital cost is on account of rolling mills and there has been a trend towards replacing the primary mills by continuous casting plants. The continuous bloom or slab casters would dispense with ingot making and soaking pits and throw up the need for high quality zircon refractories. Due to the enormous savings in time and labour arising out of their usage, there is a growing trend towards usage of monolithic refractories. (castables, ramming masses and gunning mixtures etc). They are rammed, poured or vibrated into place which renders unnecessary the design and manufacture of bricks to various shapes and then firing before shipment. Damaged portions of refractory lining can be repaired or critical areas continually maintained by gunning a layer of refractory material without shutting down the furnace.

3. The Committee took note that changes in this direction will need to be followed by Steel Industry in the country although somewhat more gradually than in some of the advanced countries. For example, for the time being, we are likely to standardize on 5 metre high coke ovens and 2000 cu. m. blast furnace of Bokaro design. Use of LD convertors and continuous casting is, however, a definite possibility in the new plants.

4. From the foregoing, it would be seen that the pattern for the future is likely to be one of lesser quantitative demand of refractories but with greater emphasis on quality. The Committee felt that the fact that industry today has a surplus of a particular type of capacity does not mean that the steel plants would have to adopt their technologies to accept such materials. On the other hand, it was obvious that the refractory industry as one of feeder industry for steel plants would have to continuously adapt itself to the technological changes and consequent changes in the type-wise demand pattern of steel industry. It is, however, clarified that the stiff plastic capacity would not be thrown out completely. The economics of production in the steel industry would govern the choice.

CHAPTER 10

STANDARDIZATION OF REFRACTORIES

The existing steel plants in the country have been set up with assistance of foreign countries like USSR, West Germany and U.K. For construction of the first phase of these plants quite a large amount of refractories were imported from countries assisting set up of plants. As a result, the qualities of refractories and shapes used for construction followed the pattern prevailing in that particular country. Over the years the steel plants have been making efforts to substitute these refractories with those produced within the country. The Indian Standards Institution has also developed a large number of standards for steel plant refractories.

2. In view of the large steel development programme envisaged and sophisticated techniques likely to be employed in these new plants, it was felt necessary that a thorough review of standards already existing should be undertaken and also new standards established where these are not prevailing.

3. The Standardization Sub-Committee was constituted at the first meeting of the Committee on Refractories held at New Delhi on 19th January, 1971.

4. The first meeting of this Sub-Committee was held on 6th April, 1971, in New Delhi. At this meeting, the statements prepared by the Indian Standards Institution covering national standards of various countries including Indian standards and some of the company standards on refractories for steel plants *vis-a-vis* the requirements of individual steel plants were discussed. All steel plants except Bokaro Steel Ltd. and Bhilai Steel Plant, were represented at this meeting. As a result of the discussions, it was agreed that:

(a) IS:484-1958 specification for silica refractories for general purposes was acceptable to all and the refractories were obtained on the basis of this specification.

(b) IS:4812-1968 Silica refractories for coke oven was acceptable.

(c) The following Indian standards on basic refractories were acceptable :

IS:1749-1961	Magnesite refractories for steel plants,
IS:3305-1965	Burnt-chrome magnesite refractories for general purposes.
IS:4813-1968	Chemically bonded chrome-magnesite refractories for general purposes.
IS:3304-1965	Burnt magnesite-chrome refractories for general purposes, and
IS:4814-1968	Chemically-bonded magnesite-chrome refractories for general purposes.

It was, however, mentioned that the question of raising the maximum limit for silica for general purpose refractories may be considered in view of the nature of raw materials available in the country.

(d) Certain modifications were suggested in the specification for fireclay refractories for steel plants including blast furnace refractories, ladle refractories, and other casting pit refractories; and

(e) IS:2042-1963 was acceptable except that certain cold crushing strength requirements and ferrous oxide may be specified for the various grades of insulating refractories.

5. In order to examine the specifications of Bokaro and Bhilai Steel Plants, a small working group consisting of CEDB, HSL, Bhilai Steel Plant, Bokaro Steel Plant and ISI representatives was constituted. A meeting of this group was arranged on 11 August, 1971 when the specifications for blast furnace refractories were discussed. The working group has now recommended to include certain permissible limits for surface defects in blast furnace refractories as also to cover 62 percent alumina bricks as an additional grade in the Indian standard. These recommendations were considered by the Refractories Committee of ISI on 21 September, 1971 when it was agreed to process the details with reference to surface defects in blast furnace refractories for incorporation in IS 1529-1971. About 62% Alumina Bricks it was, however, decided to consider standardization only after these bricks are produced in the country.

6. A general agreement has also been reached among the steel plants that steps should be taken to rationalise the sizes of refractories used in the various units. In view of the very large quantities of refractories required for lining of ladles in steel industry, it was agreed to take up this item first followed by other casting pit refractories. A technical proforma supplied by CEDB for the collection of information has been circulated to all the steel plants. Data has also been received from some organisations.

7. Regarding standardization of refractories for electric furnaces, the Steel Furnace Association of India has issued a detailed questionnaire for collection of data to consider unification of quality, shape and sizes of refractories for their use.

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CHAPTER 11

11. RAW MATERIALS

1. There has been a longstanding complaint from the refractory industry that one of the reasons why they are not able to give refractories of the qualities desired by the steel plants is the non-availability of good quality raw materials. In order to investigate this matter further to find out the possibilities of obtaining raw materials for the refractory industry from various parts of the country especially, in view of the steel expansion programme envisaged, a Sub-Committee to go into this aspect in detail was set up.

2. Data has been collected from the Indian Bureau of Mines, Geological Survey of India, the Central Glass & Ceramics Research Institute and the departments of Mines and Geology in a few States. Proforma for data on specifications and consumption norms for raw materials were circulated to the IRMA for furnishing details. It was noted that many State Governments are engaged in evaluating mineral resources in their states but the relevant data were not available. Some of the important states contributing the major share of the production of the raw-materials were approached for furnishing relevant data. So far the States of Gujarat, Madhya Pradesh, Mysore, Orissa, Rajasthan, Tamil Nadu and West Bengal have responded. Material is yet to be received from Andhra Pradesh, Bihar and Maharashtra.

The data on the refractory industry, with particular reference to resources, consumption etc. of kyanite, sillimanite and magnesite are broadly summarised in the following paragaraphs.

General Review of Industry during 1970

3. The Indian Bureau of Mines has tabulated data on 50 units (based on non-statutory basis, coverage possibly incomplete). The DGTD have, however, reported 43 units accounting for a cumulative installed capacity of 180,000 tonnes/month of refractory products till the end of February, 1971.

Mineral Consumption

4. Practically all units consume fireclay, the annual consumption being nearly 5,00,000 tonnes. During 1970, 30 units reported consumption of 366, 336 tonnes of fireclay. Next in order of consumed tonnages are raw magnesite, bauxite, China clay, chromite, kyanite, etc.

Kyanite

5. As per present indications, requirements of raw kyanite during 1970 were approximately 25,500 tonnes as follows:

(i) Requirements of calciners for export . . .	12,000 tonnes.
(ii) Requirement of indigenous refractory makers (including demand for Bokaro) . . .	13,500
	25,500

6. As against this, the total availability of raw kyanite during 1970 was of the order of 119,000 tonnes, about half of which was from the Indian Copper Corporation leases. From data furnished by units reported, it appears that production of kyanite with above 60% Al_2O_3 exceeded 78000 tonnes and that of medium grade (50-60% Al_2O_3) exceeded 90,900 tonnes. Export was mainly of standard grade.

Reserves

7. As per mineral inventory prepared by I.B.M. jointly with the Geological Survey of India the grand total of reserves of all categories and grades is 379,000 tonnes. Of these about 186,100 tonnes are indicated reserves of high grade and 40,400 tonnes are indicated reserves of low grade from the Lapso Buru deposits. Maharashtra Government have estimated 19,15,300 tonnes inferred reserves in the Dehegaon-Pimralgaon areas, where kyanite forms about 70-80% and kyanite, sillimatite together about 95% of the massive ore.

The grade-wise break-up of reserves of Bhandara, Maharashtra are as follows:

1,36,300 tonnes	$\pm$58 percent Al_2O_3
99,500 ,,	54—58 ,, ,,
82,400 ,,	50—53 ,, ,,
15,97,000 ,,	below 50 percent Al_2O_3.

Geological Survey of India have reported 67,400 tonnes of low grade rock containing about 30% kyanite in Shirbai and other areas, Singhbhum. Part of the material is in floats. Beneficiation tests are being conducted on bulk sample in the I.B.M.

Sillimanite

The principal refractory units consumed between 900 to 1000 tonnes of sillimanite during 1970, registering a considerable decrease in proportion to the consumption of kyanite. Production during the year was 4,562 tonnes. This is ascribed by the industry to the following reasons:

(i) Lower alumina content than the desired minimum of 60%.

(ii) Ferruginous encrustations in supplied raw sillimanite causing iron spots in refractories leading to heavy rejection.

(iii) Non-availability of massive variety. Available material is weathered, of high water absorption. Therefore the advantage of using sillimanite for dense products is lost.

(iv) Calcined Lapso Buro kyanite, being much cheaper than Sonapahar sillimanite, has displaced the latter wherever technically feasible. Sillimanite was used only where unavoidable, on account of special properties required.

(v) Rewa sillimanite, though cheaper, is stated to be of a vastly inferior quality. Other known/reported occurrences are also of low grade.

Reserves

2. As per mineral inventory prepared by IBM jointly with GSI reserves of all categories and grades of sillimanite total 343,400 tonnes, of which 12,000 tonnes are indicated reserves. Reserves of Assam sillimanite (in Meghalaya) about 239,100 tonnes are of 58—61% Al_2O_3 grade. Among a major resource may be mentioned the detrital sillimanite in the beach sands of Kerala. The mineral constitutes about 5—10% of the sand, the beaches stretching over 26 km in length with a width of about 30 metres. Reserves have not been estimated, although the material assays 61% Al_2O_3. The recovered mineral is indigenously consumed in making refractory and other products and some quantity is also exported.

Export: A substantial part of the sillimanite produced is exported though the trend is fluctuating and erratic over the years.

Magnesite

There are five units for the manufacture of basic refractory bricks located in Bihar, Orissa, West Bengal and Tamil Nadu. The Hindustan Steel Limited plant under erection at Bhilai may be the sixth one. There are 6 units manufacturing lightly calcined/dead burnt and sintered magnesite, of which 4 are located close to the Salem deposits and one at Jamshedpur and another at Balpahar. Practically all producers of dead-burnt magnesite have captive sources.

Production during 1970 was 348,962 tonnes, the major portion originating from the Salem deposits in Tamil Nadu. Export of both calcined and non-calcined magnesite totalled 34,154 tonnes.

Resources

As per mineral inventory prepared by IBM jointly with the GSI, reserves of *in-situ* magnesite of all grades in the country have been placed at:

Measured	1,018,000 tonnes
Indicated	22,045,000 tonnes
Inferred	29,346,900 tonnes

Of these, recoverable reserves are 802,600 tonnes (measured) in Dawaldhar deposits in U.P. 1,219,400 tonnes (indicated) and 1,520,700 tonnes (inferred) in Salem area, Tamil Nadu. Besides, a deposit of talc-magnesite of Bhitardari in Singhbhum, Bihan can also be considered as a resource.

The main problem in the Salem deposits is not one of resources, but of their recoverability. The total magnesite content in *in-situ* rock is placed at 4,875 tonnes to a depth of 30 metres, constituting about 40% of the ore *in-situ*. But under the present system of mining and sorting, only a fraction—3 to 10 per cent—of the whole bulk is obtained as saleable raw magnesite. Huge dumps of rejects analysing around 30—35 percent $MgCO_3$ are reportedly lying unutilized in the mine areas. This aspect would be checked by the Sub-Committee in detail. If this be the case, extraction and utilization of this magnesite from the dumps is an extremely vital problem.

Beneficiation and utilization

Considerable research has been done on beneficiation of low grade magnesite and preparation of refractory bricks. The data are too exhaustive to be featured in this brief note. A few points are, however, worthy of attention.

C.G.C.R.I. produced Forsterite bricks using Salem magnesite, Jabalpur fire-clay and Gangetic silt or building sands and found that Gangetic silt appeared better than Jabalpur fireclay. The bricks fired at 1600°C indicated promising results comparable with imported samples.

I.B.M. conducted tests on beneficiation of dump samples of low grade magnesite from Salem deposits. Further tests are in progress. However, it has been tentatively concluded that the high silica in the dump magnesite cannot be reduced below 2% and the weight per cent recovery of concentrate is low. However, in so far as the beneficiation of dressing rejects are concerned, it has been possible to obtain products conforming to requirements in all respects except for the fine size of the powder and the slightly high silica. There is a case for continuing studies on the problems of beneficiation of dressing rejected from the Salem area.

Tests have also indicated that Almora magnesite is superior to Salem magnesite as a fettling material and that a 1:1 blend of the two material may result in production of straight magnesite refractory bricks of acceptable quality.

General remarks

It was observed that experiments are being conducted to beneficiate kyanite. It is, however, in the country's interest that high grade material should be made available to the Refractory. Industry. If necessary, export commitments entered into for kyanite should be reviewed. The high cost of beneficiation would adversely affect the economics of the refractory industry.

Sillimanite

The deposits of sillimanite in Meghalaya are the world's best. However, production has diminished and production costs have increased due mainly to the following factors:

(a) Non-renewal of leases due to non-payment of dues to Govt. of Assam.

(b) Depletion of easily mineable resources, combined with lack of any detailed prospecting by lessee.

(c) Increased production costs due to higher overburden ratio on one hand, and higher establishment costs, broken down machinery, engagement of intermediaries like stockists, selling agents, etc.

(d) Lack of finance and stability in the company.

It is recommended that Government may examine taking over of sillimanite deposits after expiry of the current lease agreements.

CHAPTER 12

EQUIPMENT FOR MANUFACTURE OF REFRACTORIES

1. The manufacturing process for refractories can be divided into the following 4 stages:

(i) Crushing & grinding.

(ii) Forming.

(iii) Drying.

(iv) Firing.

2. For each of the 3 types of refractories, namely, fireclay, basic and silica, different types of equipment are required. Some types of equipment are available indigenously while others require import.

3. **Crushing & Grinding**

	Fireclay	Silica	Basic
(a) Primary Crushing	Jaw crushers (indigenous)	Jaw crushers (indigenous)	Jaw crushers (indigenous)
(b) Course grinding	Impact Mill or Pan Mill (indigenous)	Rod Mill and Cone Crushers (indigenous)	Mexican Mill or Cone Crusher (indigenous)
(c) Fine grinding	Ball Mill or Mexican Mill (indigenous)	Ball Mill or Mexican Mill (indigenous)	

4. After crushing, vibrating screens are required for screening the material to size and magnetic separators to remove ferrous inclusions. Vibrating screens as well as magnetic separators (both of the drum and plate type) are available indigenously.

5. The next step is to weigh the various ingredients in a batch weighing car and this is not available indigenously. The mixing of the batch is done in a mixer which is available within the country. In the case of silica refractrories, silica mixing mill with quick discharge equipment needs to be imported.

6. The mix is next to be transported to the press for which either overhead cranes or electric pulleys are employed which can be obtained indigenously.

Forming

7. There are various types of presses employed by the industry for manufacture of bricks, depending upon the quality of bricks to be produced. In the case of fireclay refractories, the presses used by the industry are:

(a) Friction Screw (Berger) with a pressure ranging from 150 to 400 tonnes.

(b) Rotary Table Press like Spengler, Laise, Bokhao and Victory, with a pressure ranging from 100 to 300 tonnes.

(c) Mechanical Toggle Press of the type Boyd , with a pressure ranging from 400 to 800 tonnes; and

(d) Hydraulic Toggle Press like, Horn, with a pressure ranging from 300 to 1,200 tonnes.

7. In the case of basic refractories, only heavy duty presses are used. There is indigenous availability for Friction Screw (Berger) upto a pressure of 150 tonnes. The rest of the presses are being imported. Schemes for manufacture of heavy duty presses have been permitted by the Government. These are in favour of M/s ACC Ltd., Bombay, M/s Cement Distributors Ltd., New Delhi, M/s Indian Sugar & General Engineering Corpn., Yamuna Nagar and M/s Ishwar Industries Ltd., New Delhi. Besides, an industrial licence has been issued to M/s Excelsior Plant Corporation, New Delhi for manufacture of heavy duty presses. It is suggested that DGTD closely follow implementation of these schemes so that the requirements of the industry are met expeditiously.

8. **Drying**

The facilities for drying can be installed with local talents and the only equipment that has to be imported is the Hydraulic Pusher.

9. **Firing**

Firing or burning or refractories is accomplished through use of three different types of kilns. These are down draft kilns, chamber kilns or continuous tunnel kilns. The know-how for construction of down draft kilns is available indigenously while for chamber kilns and tunnel kilns, engineering drawings have to be imported. The other imported equipments required for tunnel kilns are Hydraulic Pusher, Roll Shutter Doors capable of withstanding high temperature, firing equipment like burners and hot air fans. The items of equipment available indigenously for kilns are motors and recording instruments.

CHAPTER 13

ACKNOWLEDGEMENT

The task of compiling details of demand and availability of refractories was indeed very great and it would not have been possible to do so in the time available to the Committee but for the willing co-operation extended by all the Members of the Committee, the General Managers of the Steel Plants and the Chairman and the Member units of the Indian Refractory Makers' Association. Special mention is, however, necessary for the assistance rendered by Shri R.N.S. Iyer, who was the coordinator for the Sub-Committee which made an assessment of the availability of refractories from the refractory industry and Mr. S.R. Khanna, Development Officer, DGTD, who was the co-ordinator of the Sub-Committee which made an analysis of the demand projections. I thank Shri K.K. Bandhopadhyaya of the Rourkela Steel Plant, Shri I.C. Modi of Durgapur Steel Plant, Shri S.K. Mukherji of the Bhilai Steel Plant, Shri P.S. Sundaram of Rourkela Steel Plant, Shri K.S. Swaminathan of Tata Iron and Steel Company, Shri Gupta Roy of Indian Iron & Steel Company and Shri J.R.K Murty of the Harry Refractories and Ceramics Private Ltd., who made significant contributions to the work of this Committee.

2. I am also grateful to Dr. S.P. Verma, Industrial Adviser, DGTD, Dr. S.S. Ghose, Deputy Chairman, Indian Refractory Makers' Association, Shri M.H. Dalmia of Orissa Cement Ltd.and Shri Kamal Morarka of India Firebricks and Insulation Co. Ltd., who have either served on the Sub-Committees for making an assessment of the demand and availability projections or whose knowledge and understanding of the subject were extremely useful in the deliberations of the Committee.

3. There was a large amount of statistical data which had tobe analysed, compiled, checked and rechecked. I am grateful to Shri T.R. Anantharaman and Shri N.S. Murdeshwar, Senior Refractories Engineer of the Central Engineering and Design Bureau for their wholehearted assistance in this respect.

4. I thank Shri D.S. Chabbal, Development Officer of the DGTD and Dr. D.N. Nandi of the CGCRI for their contribution to the Chapters on Historical Development of Refractory Industry, and usage of Refractories in Steel Plants.

5. Finally, I would like to express my sincere thanks to Shri S. Vangala, Member-Secretary for his painstaking efforts and systematic approach and untiring patience in the Committee's work. I am also thankful to the various members of the staff of the Department of Steel for rendering secretarial assistance in compilation of this Report.

(Sd) HARI BHUSHAN

CONTENTS

ANNEXURE A

ANNEXURE A

(To be published in the Gazette of India, Part I, Section I)

No. RM-5(6)/70

GOVERNMENT OF INDIA

MINISTRY OF STEEL AND HEAVY ENGINEERING

New Delhi, dated 7-1-1971

RESOLUTION

Serious shortage in the supply of refractories of requisite quality and in adequate quantities to the steel plants have been affecting the production in the existing steel plants as well as the construction schedule of the Bokaro Steel Plant. Adequate availability of refractories of various categories and of the required specifications is essential to meet the recurring operational and maintenance requirements of the steel plants and for the creation of new capacities for production of iron and steel. To plan the production of refractories to fit in with the steel development programme, Government have decided to appoint a Committee to examine this problem in all its aspects and to make suitable recommendations. The terms of reference of this Committee shall be as under:—

(a) To make a quantitative estimate of the requirements of different categories of refractories, by type and quality, needed by the Steel Industry in the next 5 years both for maintenance and construction purposes;

(b) To assess the existing installed capacity in the country for the manufacture of different categories of refractories, to analyse reasons for shortfalls in production and to suggest suitable measures to raise the production to the level of rated capacity;

(c) To examine and recommend the extent of additional capacity that should be set up, and in what stage, to meet adequately the needs of the Steel Industry as a whole in the next 15 years, the number and optimum size of the units required, the relative economics of setting up new units vis-a-vis increasing the capacity of existing units or reviving units which have closed down for various reasons and the extent to which new units should be get up in the public sector either as captive units or otherwise;

(d) To assess the capacity available in the country for manufacture of plant and equipment needed for the manufacture of refractories and recommend suitable measures to meet the likely demand for such equipment;

(e) To examine the scope of standardisation in the specifications for refractories and to make suitable recommendations;

(f) To assess the availability of the resources of raw materials such as magnesite, chromite, bauxite etc. to support the development of refractory industry in the country; and

(g) Any other matter germane to the subject.

2. The following will be the composition of the Committee:—

1.	Shri Hari Bhushan, Senior Industrial Adviser, Ministry of Steel and Heavy Engineering	*Chairman.*
2.	Shri T.R. Anantharaman, Superintendent (Refractories), Central Engineering and Design Bureau, Hindustan Steel Ltd. Ranchi.	*Member.*
3.	Dr. V.G. Bhatia, Economic Adviser, Ministry of Steel and Heavy Engg.	*Member.*
4.	Dr. S.P. Varma, Industrial Adviser, Directorate General of Technical Development	*Member.*
5.	A representative of the Refractories Industry to be nominated by the Indian Refractory Makers' Association, Royal Exchange, 6, Netaji Subash Road, Calcutta-1.	*Member.*
6.	Shri N.B. Ghosh, Senior Geologist, Geological Survey of India, 27, Jawahar Lal Nehru Road, Calcutta-13.	*Member.*
7.	Shri J.C. Banerjee, Dy. Director, Central Glass and Ceramic Research Institute, Jadavpur, Calcutta.	*Member.*

8. A representative of the Indian Standards Institute, Manak Bhavan B.S. Zafar Marg, New Delhi — *Member.*

9. Shri S. Vangala, Development Officer, Ministry of Steel and Heavy Engineering. — *Member-Secretary*

The Committee should submit its report as early as possible, but not later than 30th April, 1971.

(SD) K.G.R. IYER,
Joint Secretary to the Govt. of India

No. RM-5(6)/70 — NEW DELHI, dated the 7th Jan. 1971

ORDER

Ordered that copy of the Resolution be communicated to all concerned. Ordered also that the Resolution be published in the *Gazette of India* for general information.

(Sd.) K.G.R. IYER
Joint Secretary to the Govt. of India

सत्यमेव जयते

ANNEXURE B

Availability of Refractories

Name of the Unit

Type of Refractories	Installed capacity	Production capacity	Actual production 1970	Estimated Production (in' 000 Tonnes) 1971	1972	1973
I. *Fireclay*						
(a) Ladles						
(i) Steel						
(ii) Blast Furnace						
(iii) Electric Steel						
(b) Checkers Open Hearth						
(c) Checkers Blast Furnace						
(d) Checkers Coke Oven						
(e) Soaking Pit Covers						
(f) Blast Furnace						
(i) Hearth						
(ii) Bosh						
(iii) Inwall						
(iv) Stoves and auxiliaries						
(g) Coke Oven Shapes						
(h) Others (Reheating Furnace, Soaking Pit etc.)						
(j) Pouring refractories						
(i) Steel						
(ii) Electric Steel						
II. *High Alumina* (45 to 75%, Al_2O_3)						
III. *Basic*						
(a) Burnt						
(b) Unburnt (chemically bonded)						
(c) Tar bonded dolomite						
IV. *Silica*						
(a) Coke Oven						
(b) Open Hearth Roof and or Electric Furnace Roofs						
(c) Converters						
(d) Others						
V. *Insulation*						
(i) Mica						
(ii) Vermiculite						
(iii) Diatomite						
(iv) Fireclay base						
(v) Light weight fireclay						
(vi) Others						

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Type of Refractories	Installed capacity	Production capacity	Actual production 1970	Estimated Production (in '000 Tonnes)		
				1971	1972	1973
VI. *Mortars*						
(i) Fireclay						
(ii) Silica						
(iii) High Alumina						
(iv) Basic						
(v) Insulating						
VII. *Masses, Castables* (carbon paste, Carbon Ramming Mass, Tar dolomite Ramming Mass, Basic Ramming Mass, High Alumina Ramming Mass and others).						
VIII. *Granulated Refractories* (Pea Magnesite Burnt & dolomite Chips and others.)						
IX. *Special Refractories* [Castables (special) silicon carbide, High Alumina (above 75%) fuse cast, Graphite carbon blocks, Zircon refractories and any other type].						
X. *Acid proof Bricks*						

Name of the Unit

ANNEXURE B Pt. B

Requirement of Refractories operation capital repairs new construction

Steel Production (In '000 tonnes)	Year/Tonnage	1971	72	73	74	75	76	77	78	79

Type of Refractories	Consumption Norms 1969	Consumption Norms 1970	Process Dry/Wet	Requirement (In '000 tonnes) 1971	72	73	74	75	76	77	78	79
I. *Fireclay*												
(a) Ladles												
(i) Steel												
(ii) Blast Furnace												
(iii) Electric Steel												
(b) Checkers Open Hearth												
(c) Checkers Blast Furnace												
(d) Checkers Coke Ovens												
(e) Soaking Pit Covers												
(f) Blast Furnace												
(i) Hearth												
(ii) Bosh												
(iii) Inwall												
(iv) Stoves and auxiliaries												
(g) Coke Oven Shapes												
(h) Others (Reheating Furnace, Soaking Pit etc.)												
(j) Pouring refractories												
(i) Steel												
(ii) Electric Steel												
II. *High Alumina* (45 to 75%, Al_2O_3)												
III. *Basic*												
(a) Burnt												
(b) Unburnt (chemically bonded)												
(c) Tar bonded dolomite												
IV. *Silica*												
(a) Coke Oven												
(b) Open Hearth Roof and or Electric Furnace Roofs												
(c) Converters												
(d) Others												
V. *Insulation*												
(i) Mica												
(ii) Vermiculite												
(iii) Diatomite												
(iv) Fireclay base												
(v) Light weight fireclay												
(vi) Others												

Name of the Unit

ANNEXURE B Pt B

Requirement of Refractories operation capital repairs new construction

Steel Production (in '000 tonnes)	Year/Tonnage			1971	72	73	74	75	76	77	78	79
				Requirements (in '000 tonnes)								
Type of Refractories	Consumption Norms		Process Dry/Wet	1971	72	73	74	75	76	77	78	79
	1969	1970										
VI. *Mortars*												
(i) Fireclay												
(ii) Silica												
(iii) High Alumina												
(iv) Basic												
(v) Insulating												
VII. *Masses, Castables* (carbon paste, Carbon Ramming Mass, Tar dolomite Ramming Mass, Basic Ramming Mass, High Alumina Ramming Mass and others).												
VIII. *Granulated Refractories* (Pea Magnesite Burnt Dolomite Chips and others).												
IX. *Special Refractories* [Castables (special) silicon carbide, High Alumina (above 75%) fuse cast, Graphite carbon blocks, Zircon refractories and any other type].												
X. *Acid Proof Bricks*												

ANNEXURE C

ANNEXURE C

Consumption of Steel Plant Refractories

Fireclay Refractories

PLANT	ACTUAL CONSUMPTION '70-71 Kg/Tonne of Steel	Projected Norm Upto 1975-76
IISCO	60*	40.0
TISCO	42.0	38.0
ROURKELA	26.0	25.0
BHILAI	26.0	26.0
DURGAPUR	38.5	40.0
ASP	120	144
MISL	33.0	33.0
BOKARO	—	—
ELEC. FURNACES	15.0	15.0

NOTES:

* Includes relining of 1 Blast Furnace.

1. Norms do not include requirement of mortar.
2. Operational and capital repair requirements are included.
3. HSL figures do not include High Alumina requirement which amounts to 3% of Fire clay requirement.
4. Similarly in the case of Bokaro, High Alumina requirement of 3% of Fireclay refractories is also not included.
5. Norms vary from Plant to Plant due to the process and the age of plant. Depending on incidence of capital repairs to blast furnaces these would vary.
6. Ferro Alloy Producers' annual requirement: 540T (inclusive of High Alumina).

ANNEXURE I

Basic Refractories

Plant	Consumption in 70-71 Kg/Tonne		Projected norms upto 75-76 Kg/Tonne	
	Burnt	Chemically bonded	Burnt	Chemically bonded
IISCO	6.0	3.0	6.0	3.0
TISCO	4.5	2.5	5.0	3.0
ROURKELA	2.9	1.2	3.5	1.5
BHILAI	13.55	5.5	18.3	13.6
DURGAPUR	5.0	14.0	6.0	16.6
ASP	11.0	16.0	11.0	16.6
BOKARO	..	..	1.1	

Durgapur and Bhilai's requirements consider Oxygen blowing in Open Hearth Furnaces.

Norms for Elect. Furnaces is 8.6 Kg/T comprising of Magnesite 6.6 Kg/T Mag Cr. 1.0 Kg/T Chrome Mg. 1.0 Kg/T.

3. Ferro Alloy Producers' Annual requirement : 500.

ANNEXURE II

Silica Refractories

Plant	Consumption 70-71 Kg/T	Projected norms upto 75-76 (Kg/T)
ISSCO	16.2	16.2
TISCO	12.0	10.0
HSL	2.4	2.4
MISL	13.0	13.0
Electric Furnaces . . . (Roof : 4.7 Non-roof : 0.9)	5.6	5.6

Ferro Alloy producers do not require Silica Refractories.

ANNEXURE III

Dead Burnt Magnesite (for fettling)

IISCO	3.0 Kg/T
TISCO	3.3 „
Rourkela	3.15 „
Bhilai	10.00 „
Durgapur	4.00 „
Electric Furnaces	7.00 „

*The norm is higher in the case of Bhilai due to their Bottom burning practice which was agreed to be a good method to which other plants are also considering a change over.

ANNEXURE D

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Fire clay (1971 to 1985)

Demand of FIRECLAY (INCLUDING HIGH ALUMINA) *Refractories for Steel Industry* 1971 *to* 1985

Name of the Plants		1971				1972			
		HA	HG	LG	PL	HA	HG	LG	PL
Rourkela		0.4	0.3	23.5	2.0	2.3	2.0	30.5	5.3
Bhilai		0.2	27.6	..	34.5	0.2	27.8	..	40.2
Durgapur		0.7	3.3	28.2	17.6	0.8	4.1	40.8	19.7
ASP		0.3	..	2.1	8.3	0.3	..	2.1	8.3
TISCO		2.2	12.7	42.4	27.0	4.5	16.3	34.6	27.6
IISCO		0.2	..	3.1	51.2	0.2	..	3.0	55.0
MISCO		2.3	..	..	..	2.3	..	..	..
Bhilai Exp.	C	..	..	..	..	..	..	..	..
	O	..	..	..	..	..	..	..	..
Bokaro	C	..	..	0.7	..	4.3	1.4	10.4	..
	O	..	..	..	..	0.2	3.0	1.6	0.2
NP I	C	..	..	..	..	..	..	..	..
	O	..	..	..	..	..	..	..	..
NP II	C	..	..	..	..	..	..	..	..
	O	..	..	..	..	..	..	..	..
NP III	C	..	..	..	..	..	..	..	..
	O	..	..	..	..	..	..	..	..
NP IV	C	..	..	..	..	..	..	..	..
	O	..	..	..	..	..	..	..	..
NP V	C	..	..	..	..	..	..	..	..
	O	..	..	..	..	..	..	..	..
Hospet	C	..	..	..	..	..	..	..	..
	O	..	..	..	..	..	..	..	..
Vizag	C	..	..	..	..	..	..	..	..
	O	..	..	..	..	..	..	..	..
F. Alloy		0.6	..	0.4	..	0.3	..	0.1	..
S.F.A.I.		..	9.9		5.9	..	14	..	9
TOTAL		6.9	53.2	100.4	146·5	15.4	68.6	123.1	165.3

Demand of **FIRECLAY (INCLUDING HIGH ALUMINA)** *Refractories for Steel Industry* 1971 *to* 1985

Name of the Plants		1973				1974			
		HA	HG	LG	PL	HA	HG	LG	PL
Rourkela		1.9	1.6	30.7	5.1	1.9	1.6	28.9	3.2
Bhilai		0.2	30.9	..	46.4	0.2	30.6	5.0	37.3
Durgapur		0.9	..	25.2	21.4	1.0	3.2	36.9	30.1
ASP		0.3	..	2.1	8.3	0.3	..	2.1	8.3
TISCO		3.4	16.3	34.6	27.6	4.4	16.3	34.3	25.4
IISCO		0.2	..	3.1	50.0	0.2	..	3.0	67.6
MISCO		2.3	..	..	..	2.3	..	..	..
Bhilai Exp.	C	..	2.8	2.8	2.8	..	1.9	1.9	1.8
	O	..	..	..	..	..	..	..	..
Bokaro	C	9.0	1.6	10.7	..	9.0	1.8	11.5	..
	O	0.5	8.8	4.9	0.6	0.6	11.8	6.5	0.8
NP I	C	..	..	..	..	..	..	..	..
	O	..	..	..	..	..	..	..	..
NP II	C	..	..	..	..	..	..	..	..
	O	..	..	..	..	..	..	..	..
NP III	C	..	..	..	..	..	..	..	..
	O	..	..	..	..	..	..	..	..
NP IV	C	..	..	..	..	..	..	..	..
	O	..	..	..	..	..	..	..	..
NP V	C	..	..	..	..	..	..	..	..
	O	..	..	..	..	..	..	..	..
Hospet	C	..	..	..	..	6.5	3.5	18.0	..
	O	..	..	..	..	..	..	..	..
Vizag	C	..	..	..	..	6.5	3.5	17.5	..
	O	..	..	..	..	..	..	..	..
F. Alloys		0.5	..	0.1	..	0.4	..	0.1	..
S.F.A.I.		..	16	..	9.6	..	18.0	..	10.4
TOTAL		**19.2**	**78**	**114.2**	**171.8**	**33.3**	**92.2**	**165.7**	**184.9**

Demand of **FIRECLAY (INCLUDING HIGH ALUMINA)** *Refractories for Steel Industry* 1971 *to* 1985

Name of the Plants		1975 HA	1975 HG	1975 LG	1975 PL	1976 HA	1976 HG	1976 LG	1976 PL
Rourkela		1.9	1.6	32.1	7.2	0.7	0.3	26.7	2.0
Bhilai		0.2	30.6	5.0	37.3	0.2	30.6	5.0	37.3
Durgapur		1.0	3.3	36.9	24.1	1.0	3.2	36.9	24.0
ASP		0.3	..	2.1	8.3	0.3	..	2.1	8.3
TISCO		4.4	16.3	34.3	27.0	2.2	16.3	34.1	21.6
IISCO		0.2	..	2.5	60.4	0.2	..	1.0	68.8
MISCO		2.3	..	..	..	2.3	..	..	..
Bhilai Exp.	C	..	1.9	1.9	1.8	..	0.9	0.9	1.0
	O	0.4	10.0	2.8	0.5	0.71	18.6	15.0	0.9
Bokaro	C	..	0.3	2.5	..	..	..	..	..
	O	0.8	15.0	8.3	1.0	1.1	20.6	11.3	1.4
NP I	C	6.5	3.5	18.0	..	6.5	8.5	18.0	..
	O	..	..	..	..	..	..	..	..
NP II	C	..	..	..	..	6.5	3.5	18.0	..
	O	..	..	..	..	..	..	..	..
NP III	C	..	..	..	..	..	..	..	..
	O	..	..	..	..	..	..	..	..
NP IV	C	..	..	..	..	..	..	..	..
	O	..	..	..	..	..	..	..	..
NP V	C	..	..	..	..	..	..	..	..
	O	..	..	..	..	..	..	..	..
Hospet	C	6.5	36.5	18.0	18.0	6.5	3.5	18.0	..
	O	..	..	..	..	..	..	..	..
Vizag.	C	6.5	3.5	17.5	..	6.5	3.5	17.5	..
	O	..	..	..	..	..	..	..	..
F. Alloys		0.7	..	0.1	..	0.2	..	0.1	..
S.F.A.I.		..	19.4	..	12.0	..	22.0	..	13.0
TOTAL		31.7	108.9	182.0	179.6	34.9	126.5	194.6	178.3

Demand of **FIRECLAY (INCLUDING HIGH ALUMINA)** *Refractories for Steel Industry* 1971 *to* 1985

Name of the Plants		1977				1978			
		HA	HG	LG	PL	HA	HG	LG	PL
Rourkela		1.7	2.5	26.5	2.2	1.5	1.9	29.7	6.2
Bhilai		0.2	30.6	5.0	37.3	0.2	30.6	5.0	37.3
Durgapur		1.0	3.2	36.9	30.1	1.0	3.2	36.9	23.6
ASP		0.3	..	2.0	8.3	0.3	..	2.1	8.3
TISCO		2.2	16.3	35.1	21.6	2.2	16.3	34.1	21.6
IISCO		0.2	..	0.2	59.2	0.2	..	00.1	59.3
MISL		2.3	..	..	..	2.3	..	..	..
Bhilai Expn.	C	..	..	..	..	..	..	..	..
	O	0.9	29.8	6.2	1.1	1.0	26.9	7.3	1.3
Bokaro	C	..	..	..	..	..	..	..	..
	O	1.4	26.5	14.6	1.8	1.7	30·5	16.8	2.1
NP. I	C	6.5	3.5	18.0	..	3.5	1.5	9.0	..
	O	..	..	..	..	0.8	20.7	5.6	1.0
NP. II	C	6.5	3.5	18.0	..	6.5	3.5	18.0	..
	O	..	..	..	..	..	..	..	..
NP. III	C	6.5	3.5	18.0	..	6.5	3.5	18.0	..
	O	..	..	..	..	..	..	..	..
NP. IV	C	..	..	..	..	6.5	3.5	18.0	..
	O	..	..	..	..	..	..	..	..
NP. V	C	..	..	..	..	..	..	..	..
	O	..	..	..	..	..	..	..	..
Hospet	C	3.5	1.5	9.0	..	3.0	2.0	9.0	..
	O	0.8	20.7	5.6	1.0	1.2	30.6	8.4	1.5
Vizag	C	3.5	1.5	8.8	..	3.0	2.0	9.0	..
	O	0.8	23.2	5.6	1.0	1.2	30.6	8.4	1.5
Ferro Alloys		0.4	..	0.1	0.7	0.5	..	0.1	..
SFAI		..	24.3	..	14.6	..	27.4	..	16.5
TOTAL		38.7	190.6	208.7	178.2	43·1	234.7	235.7	180.2

Demand of **FIRECLAY (INCLUDING HIGH ALUMINA)** *Refractories for Steel Industry* 1971 *to* 1985

Name of the Plants		1979				1980			
		HA	HG	LG	PL	HA	HG	LG	PL
Rourkela		1.5	1.9	30.6	7.4	1.5	1.9	26.5	2.0
Bhilai		0.2	30.6	5.0	37.3	0.2	30.6	5.0	37.3
Durgapur		1.0	3.3	36.9	23.6	1.0	3.2	36.9	23.6
ASP		0.3	..	2.1	8.3	0.3	..	2.1	8.3
TISCO		2.2	16.3	34.1	21.6	2.2	16.3	34.1	21.6
IISCO		0.2	..	..	60.6	0.2	..	..	60.6
MISL		2.3	..	..	..	2.3	..	..	..
Bhilai Exp.	C	..	..	..	..	..	..	..	..
	O	1.0	26.9	7.3	1.3	1.0	26.9	7.3	1.3
Bokaro	C	..	..	..	..	..	..	..	..
	O	1.8	33.4	18.4	2.3	2.2	40.8	22.6	2.8
NP. I	C	3.0	2.0	9.0	..	3.0	2.0	9.0	..
	O	1.2	30.6	8.4	1.5	1.6	41.4	11.2	2.0
NP. II	C	3.5	1.5	9.0	..	3.0	2.0	9.0	..
	O	0.8	20.7	5.6	1.0	1.2	30.6	8.4	1.5
NP. III	C	6.5	3.5	18.0	..	3.5	1.5	9.0	..
	O	..	..	..	..	0.8	20.7	5.6	1.0
NP. IV	C	6.5	3.5	18.0	..	6.5	3.5	18.0	..
	O	..	..	..	..	..	..	..	..
NP. V	C	6.5	3.5	18.0	..	6.5	3.5	18.0	..
	O	..	..	..	..	..	..	..	..
Hospet	C	3.0	2.0	9.0	..	..	..	..	..
	O	1.6	41.4	11.2	2.0	1.6	41.4	11.2	2.0
Vizag	C	3.0	2.0	9.0	..	..	..	..	..
	O	1.6	41.4	11.2	2.0	1.6	41.4	11.2	2.0
Ferro Alloys		0.3	..	0.1	..	0.7	0.1	0.1	..
SFAI		..	30.5	..	2.0	..	33.5	..	2.0
TOTAL		**48.0**	**288.0**	**260.9**	**187.1**	**47.4**	**344.7**	**263.2**	**286.0**

Demand of **FIRECLAY (INCLUDING HIGH ALUMINA)** *Refractories for Steel Industry* 1971 *to* 1985

Name of the Plants		1981				1982			
		HA	HG	LG	PL	HA	HG	LG	PL
Rourkela		1.5	1.9	26.5	2.0	1.5	1.9	26.5	2.0
Bhilai		0.2	30.6	5.0	37.3	0.2	30.6	5.0	37.3
Durgapur		1.0	3.2	36.9	23.6	1.0	3.2	36.9	23.6
ASP		0.3	..	2.1	8.3	0.3	..	2.1	8.3
TISCO		2.2	16.3	34.1	21.6	2.2	16.3	34.1	21.6
IISCO		0.2	..	..	60.6	0.2	..	..	60.6
MISCO		2.3	..	..	..	2.3	..	..	..
Bhilai Expn.	C	..	..	..	..	..	..	..	..
	O	1.0	26.9	7.3	1.3	1.0	26.9	7.3	1.3
Bokaro	C	..	..	..	..	..	..	..	..
	O	2.4	45.0	24.9	3.0	3.2	60.0	33.2	4.0
NP I	C	..	..	..	..	..	..	..	..
	O	1.6	41.4	11.2	2.0	1.6	41.4	11.2	2.0
NP II	C	3.0	2.0	9.0	..	..	..	..	..
	O	1.6	41.4	11.2	2.0	1.6	41.4	11.2	2.0
NP III	C	3.0	2.0	9.0	..	3.0	2.0	9.0	..
	O	1.2	30.6	8.4	1.5	1·6	41.4	11.2	2.0
NP IV	C	3.5	1.5	9.0	..	3.0	2.0	9.0	..
	O	0.8	20.7	5.6	1.0	1.2	30.6	8.4	1.5
NP V	C	6.5	3.5	18.0	..	3.5	1.5	9.0	..
	O	..	..	..	..	0.8	20.7	5.6	1.0
Hospet	C	1.6	41.4	11.2	2.0	1.6	41.4	11.2	2
	O	..	..	..	..	..	..	..	..
Vizag.	C	1.6	41.4	11.2	2.0	1.6	41.4	11.2	2
	O	..	..	..	..	..	..	..	..
F.A.		0.7	..	0.1	..	0.7	..	0.1	..
S.F.A.I.		..	36.5	..	22	..	39.5	..	24.0
TOTAL		**49.2**	**393.3**	**276.7**	**190.9**	**51.6**	**452.7**	**296.2**	**195.2**

Demand of **FIRECLAY (INCLUDING HIGH ALUMINA)**
Refractories for Steel Industry 1971 *to* 1985

Name of the Plants		1983 HA	1983 HG	1983 LG	1983 PL	1984 HA	1984 HG	1984 LG	1984 PL
Rourkela		1.5	1.9	26.5	2.0	1.5	1.9	26.5	2.0
Bhilai		0.2	30.6	5.0	37.3	0.2	30.6	5.0	37.3
Durgapur		1.0	3.2	36.9	23.6	1.0	3.2	36.9	23.6
ASP		0.3	..	2.1	8.3	0.3	..	2.1	8.3
TISCO		2.2	16.3	34.1	21.6	2.2	16.3	34.1	21.6
IISCO		0.2	..	..	60.6	0.2	..	..	60.6
MISCO		2.3	..	..	..	2.3	..	..	...
Bhilai Expn.	C	..	..	..	..	..	..	..	..
	O	1.0	26.9	7.3	1.3	1.0	26.9	7.3	1.3
Bokaro	C	..	..	..	..	..	..	..	..
	O	3.2	60.0	33.2	4.0	3.2	60.0	33.2	4.0
NP I	C	..	..	..	..	..	..	..	..
	O	1.6	41.4	11.2	2.0	1.6	41.4	11.2	2.0
NP II	C	..	..	..	..	..	..	..	..
	O	1.6	41.4	11.2	2.0	1.6	41.4	11.2	2.0
NP III	C	..	..	..	..	..	..	..	..
	O	1.6	41.4	11.2	2.0	1.6	41.4	11.2	2.0
NP IV	C	3.0	2.0	9.0	..	..	..	..	..
	O	1.6	41.4	11.2	2.0	1.6	41.4	11.2	2.0
NP V	C	3.0	2.0	9.0	..	3.0	2.0	9.0	..
	O	1.2	30.6	8.4	1.5	1.6	41.4	11.2	2.0
Hospet	C	1.6	41.4	11.2	2	1.6	41.4	11.2	2
	O	..	...	..	..	..	..	..	..
Vizag	C	1.6	41.4	11.2	2	1.6	41.4	11.2	2
	O	..	..	..	..	..	..	..	..
F.A.		0.7	..	0.1	..	0.7	..	0.1	..
S.F.A.I.		..	52.5	..	26	..	55.5	..	28
TOTAL		**53.2**	**507.1**	**307.4**	**199.2**	**54.8**	**551.5**	**318.6**	**203.2**

Demand of **FIRECLAY (INCLUDING HIGH ALUMINA)** *Refractories for Steel Industry* 1971 *to* 1985

	1985			
	H.A.	H.G.	L.G.	P.L.
Rourkela	1.5	1.9	26.5	2.0
Bhilai	30.6	30.6	5.0	37.3
Durgapur	1.0	3.2	36.9	23.6
ASP	0.3	..	2.1	8.3
TISCO	2.2	16.3	34.1	21.6
IISCO	0.2	..	..	60.6
MISCO	2.3	..	..	..
Bhilai Expn. C	..	..	..	..
O	1.0	26.9	7.3	1.3
Bokaro C	..	..	..	..
O	3.2	60.0	33.2	4.0
NP I C	..	..	..	..
O	1.6	41.4	11.2	2.0
NP II C	..	..	..	..
O	1.6	41.4	11.2	2.0
NP III C	..	..	..	..
O	1.6	41.4	11.2	2.0
NP IV C	..	..	..	..
O	1.6	41.4	11.2	2.0
NP V C	..	..	..	..
O	1.6	41.4	11.2	2.0
Hospet C	1.6	41.4	11.2	2
O	..	..	..	..
Vizag C	1.6	41.4	11.2	2
O	..	..	..	..
F.A.	0.7	..	0.1	..
S.F.A.I.	..	57.5	..	30
TOTAL	**55.4**	**594.9**	**329.8**	**207.2**

Basic Refractories (1971—1985)

BASIC *Refractories requirement during* 1971 *to* 1985 *for the Steel Industry*

Year		1971		1972		1973		1974	
Type		B	CB	B	CB	B	CB	B	CB
ASP		1.0	1.5	1.0	1.5	1.0	1.5	1.0	1.5
BSP	OH	29.8	12.1	32·5	13.2	33.9	13.8	33.9	13.8
	LD							1.5	
DSP		4.3	13.0	5.0	14.5	5.5	16.3	6.0	18.0
RSP		3.1	2.0	4.2	2.0	4.2	2.0	3.9	2.0
IISCO		6.9	2.5	6.9	2.5	6.9	2.5	8.2	2.5
TATA		9.6	5.4	9.5	5.5	9.5	5.5	9.5	5.5
MISL		5.9	..	5.9	..	5.9	..	5.9	..
SFAI		9.5	..	13.7	..	15.1	..	16.6	..
BOKARO		1.0	..	1.6	..	2.6	..	3.2	..
SALEM		..	..	..	..	..	..	1.2	..
HOSPET		..	..	..	..	..	..	..	..
VIZAG		..	..	..	..	..	..	..	..
NSP I to IV		..	..	..	..	..	..	..	..
TOTAL		**71.1**	**36 .5**	**80.3**	**39.2**	**84.6**	**41.6**	**90.9**	**43.3**

Year		1975		1976		1977		1978	
Type		B	CB	B	CB	B	CB	B	CB
ASP		1.0	1.5	1.0	1.5	1.0	1.5	1.0	1.5
BSP	OH	33.9	13.8	33.9	13.8	33.9	13.8	33.9	13.8
	LD	2.9	..	2.5	..	3.0	..	3.50	..
DSP		6.0	18.0	6.0	18.0	6.0	18.0	6.0	18.0
RSP		3.7	2.0	3.8	2.0	4.0	2.0	4.0	2.0
IISCO		6.9	2.0	4.6	1.0	3.8	0.5	3.8	0.5
TATA		9.5	5.5	9.5	5.5	9.5	5.5	9.5	5.5
MISL		5.9	..	5.9	..	5.9	..	5.9	..
SFAI		18.5	..	20.5	..	22.8	..	25.4	..
BOKARO		3.6	..	3.8	..	4.9	..	5.6	..
SALEM		1.2	..	0.4	..	0.7	..	0.7	..
HOSPET		3.0	..	1.0	..	2.7	..	4.1	..
VIZAG		3.0	..	1.0	..	2.0	..	3.0	..
NSP I to IV		..	..	3.0	..	4.0	..	6.7	..
TOTAL		**99.1**	**42.8**	**96.9**	**41.8**	**104.2**	**41.3**	**113.1**	**41.3**

BASIC *Refractories requirement during* 1971 *to* 1985 *for the Steel Industry*

Year / Type		1979 B	1979 CB	1980 B	1980 CB	1981 B	1981 CB	1982 B	1982 CB	Remarks
ASP		1.0	1.5	1.0	1.5	1.0	1.5	1.0	1.5	
BSP	OH	33.9	13.8	33.9	13.8	33.9	13.8	33.9	13.8	
	LD	4.1	..	4.1	...	4.1	..	4.1	..	
DSP		6.0	18.0	6.0	18.0	6.0	18.0	6.0	18.0	
RSP		4.0	2.0	4.0	2.0	4.0	2.0	4.0	2.0	
IISCO		3.8	0.5	3.8	0.5	3.8	0.5	3.8	0.5	
TATA		9.5	5.5	9.5	5.5	9.5	5.5	9.5	5.5	
MISL		5.9	..	5.9	..	5.9	..	5.9	..	
SFAI		28.1	..	31.2	..	34.3	..	37.4	..	
BOKARO		6.1	..	7.5	..	8.1	..	11.2	..	
SALEM		0.7	..	0.7	..	0.7	..	0.7	..	
HOSPET		5.4	..	5.4	..	5.4	..	5.4	..	
VIZAG		4.0	..	4.0	..	4.0	..	4.0	..	
NSP I to IV		10.8	..	16.2	..	18.6	..	26.0	..	
TOTAL		**123.3**	**41.3**	**133.2**	**41.3**	**139.3**	**41.3**	**152.9**	**41.3**	

Year / Type		1983 B	1983 CB	1984 B	1984 CB	1985 B	1985 CB	Remarks
ASP		1.0	1.5	1.0	1.5	1.0	1.5	
BSP	OH	33.9	13.8	33.9	13.8	33.9	13.8	
	LD	4.1	..	4.1	..	4.1	..	
DSP		6.0	18.0	6.0	18.0	6.0	18.0	
RSP		4.0	2.0	4.0	2.0	4.0	2.0	
IISCO		3.8	0.5	3.8	0.5	3.8	0.5	
TATA		9.5	5.5	9.5	5.5	9.5	5.5	
MISL		5.9	..	5.9	..	5.9	..	
SFAI		40.5	..	43.6	..	46.7	..	
BOKARO		11.2	..	11.2	..	11.2	..	
SALEM		0.7	..	0.7	..	0.7	..	
HOSPET		5.4	..	5.4	..	5.4	..	
VIZAG		4.0	..	4.0	..	4.0	..	
NSP I to IV		29.7	..	33.7	..	36.1	..	
TOTAL		**159.7**	**41.3**	**166.8**	**41.3**	**172.3**	**41.3**	

Silica bricks (1971 to 1985)

Requirement of **SILICA** *bricks during* 1971 *to* 1985 *for Steel Industry*

	1971		1972		1973		1974	
	CO	OT	CO	OT	CO	OT	CO	OT
ASP	..	0.9	..	0.9	..	0.9	..	0.9
BSP OH	2	7.9	9.4	7.9	8.0	7.9	3.5	7.9
DSP	0.5	1.2	0.5	1.3	0.5	1.4	6.5	1.4
RKL	..	0.61	6.2	0.61	5.2	0.61	1.0	0.61
SUB TOTAL	2.5	10.61	16.1	10.71	13.7	10.81	11.0	10.81
IISCO	0.1	14.9	1.2	14.9	0.1	14.9	7.1	14.9
TISCO	8.5	17.9	7.0	16.7	7.0	16.7	5.0	16.7
MISCO	..	1.8	..	1.8	..	1.8	..	1.8
SFAI	..	5.95	..	8.43	..	9.3	..	10.45
SUB TOTAL	8.6	40.55	8.2	41.83	7.1	42.7	12.1	44.05
Salem	..	..	..	..	..	..	..	..
Bokaro	2.0	..	15.5	..	10.0	..	10.5	..
Vizag	..	..	..	..	..	..	22.5	..
Hospet	..	..	..	..	..	..	21.5	..
NSP I to V	..	..	..	..	..	..	..	..
GRAND TOTAL	**13.1**	**51.16**	**39.8**	**62.54**	**20.8**	**63.51**	**67.6**	**56.86**

	1975		1976		1977	
	CO	OT	CO	OT	CO	OT
ASP	..	0.9	..	0.9	..	0.9
BSP OH	3.5	7.9	3.5	7.9	3.5	7.9
DSP	0.5	1.4	0.5	1.4	6.5	1.4
RKL	6.4	0.61	0.5	0.61	1.0	0.61
SUB TOTAL	10.4	10.81	4.5	10.81	11.0	10.81
IISCO	0.1	12.0	7.1	4.0	0.1	1.8
TISCO	6.3	16.7	1.3	16.7	0.1	16.7
MISCO	..	1.8	..	1.8	..	1.8
SFAI	..	11.5	..	12.65	..	14.3
SUB TOTAL	6.4	42.0	8.4	35.15	0.2	34.6
Salem	..	..	..	..	..	..
Bokaro	2.0	0.5	..	0.5	..	0.5
Vizag	22.5	..	..	..	0.5	..
Hospet	21.5	0.5	..	..	0.05	..
NSP I to V	21.5	..	43.0	..	43.0	0.5
SUB TOTAL	65.5	1.0	43.0	0.5	43.1	1.0
GRAND TOTAL	**82.3**	**54.81**	**55.9**	**46.46**	**54.3**	**46.41**

Requirement of **SILICA** *bricks during* 1971 *to* 1985 *for Steel Industry*

	1978		1979		1980		1981	
	CO	OT	CO	OT	CO	OT	CO	OT
ASP . . .	..	0.9	..	0.9	..	0.9	..	0.9
BSP . . .	3.5	7.9	3.5	7.9	3.5	7.9	3.5	7.9
DSP . . .	..	1.4	6.0	1.4	..	1.4	..	1.4
RKL . . .	6.4	0.61	7.3	0.61	..	0.61	..	0.61
SUB TOTAL .	9.9	10.81	16.8	10.81	3.5	10.81	3.5	10.81
IISCO . . .	0.1	1.8	0.1	1.8	0.1	1.8	0.1	1.8
TISCO . . .	0.1	16.7	0.1	16.7	0.1	16.7	0.1	16.7
MISCO . .	..	1.8	..	1.8	..	1.8	..	1.8
SFAI . . .	..	16.2	..	18.0	..	19.8	..	21.6
SUB TOTAL .	0.2	36.5	0.2	38.3	0.2	40.1	0.2	41.9
Salem . . .	..	..	..	..	..	..	..	..
Bokaro . . .	..	0.5	..	0.5	..	0.5	..	0.5
Vizag . . .	0.075	..	0.1	..	0.1	..	0.1	..
Hospet . . .	0.075	..	0.1	..	0.1	..	0.1	..
SP I to V . .	43.05	0.7	43.13	1.0	43.25	1.4	43.35	1.8
SUB TOTAL .	43.2	1.2	43.43	1.5	43.45	1.9	43.55	2.3
GRAND TOTAL .	**53.3**	**48.51**	**60.43**	**50.61**	**47.15**	**52.81**	**47.25**	**55.10**

	1982		1983		1984		1985	
	CO	OT	CO	OT	CO	OT	CO	OT
ASP . . .	..	0.9	..	0.9	..	0.9	..	0.9
BSP . . .	3.5	7.9	3.5	7.9	3.5	7.9	3.5	7.9
DSP . . .	..	1.4	..	1.4	..	1.4	..	1.4
RKL . . .	..	0.61	..	0.61	..	0.61	..	0.61
SUB TOTAL .	3.5	10.81	3.5	10.81	3.5	10.81	3.5	10.81
IISCO . . .	0.1	1.8	0.1	1.8	0.1	1.8	0.1	1.8
TISCO . . .	0.1	16.7	0.1	16.7	0.1	16.7	0.1	16.7
MISCO . .	..	1.8	..	1.8	..	1.8	..	1.8
SFAI . . .	..	23.4	..	25.2	..	27.0	..	28.8
SUB TOTAL .	0.2	43.7	0.2	45.5	0.2	47.3	0.2	49.1
Salem . . .	..	..	..	..	..	..	..	..
Bokaro . . .	..	0.5	..	0.5	..	0.5	..	0.5
Vizag . . .	0.1	..	0.1	..	0.1	..	0.1	..
Hospet . . .	0.1	..	0.1	..	0.1	..	0.1	..
NSP I to V . .	43.45	2.2	43.5	2.6	43.65	3.0	43.75	3.4
SUB TOTAL .	43.65	2.7	43.65	3.1	43.85	3.5	43.95	3.9
GRAND TOTAL .	**47.35**	**57.21**	**47.35**	**49.41**	**44.05**	**61.61**	**44.15**	**63.81**

Dead Burnt magnesite (1971 to 1985)

Demand of **DEAD BURNT MAGNESITE** *during* 1971-85 *for Steel Industry*

	1971		1972		1973	
	B	CB	B	CB	B	CB
Demand of Basic Bricks	71.1	36.5	80.3	39.2	84.6	41.6
	107.6		119.5		126.2	
Pea Magnesite required for:						
(a) Brick making	75.30		83.60		88.30	
(b) Mortar making	5.00		5.60		5.90	
(c) Ramming making	2.30		2.30		2.30	
(d) Fettling						
Rourkela	1.5		1.5		1.5	
Bhilai	13.2		29.2		20.0	
Durgapur	6.5		7.4		8.1	
ASP	0.5		0.5		0.5	
TATA	4.0		4.0		4.0	
IISCO	2.8		2.8		2.8	
MISCO	2.0		2.0		2.0	
SFAI	7.38		10.5		11.95	
TOTAL	**120.48**		**139.40**		**147.15**	

	1974		1975		1976	
	B	CB	B	CB	B	CB
Demand of basic bricks	90.9	43.3	99.1	42.8	96.9	41.8
	134.2		141.9		138.7	
Pea Magnesite required for:						
(a) Brick making	93.90		99.90		97.00	
(b) Mortar making	6.40		6.90		6·80	
(c) Ramming making	2.30		2.30		2.30	
(d) Fettling						
Rourkela	1.5		1.5		1.5	
Bhilai	20.0		20.0		20.0	
Durgapur	8.8		8.8		8.8	
ASP	0.5		0.5		0.5	
TATA	4.0		4.0		4.0	
IISCO	2.8		2.8		2.8	
MISCO	2.0		2.0		2.0	
SFAI	13.27		14.65		14.65	
TOTAL	**155.47**		**162.75**		**159.70**	

NOTES:

1. For Bricks making, mortar and ramming mass one tonne of basic material is assumed to require 700 Kg. of Dead Burnt Magnesite.
2. Mortar requirement has been taken as 10% of burnt basic bricks by weight.

Demand of **DEAD BURNT MAGNESITE** *during* 1971-85 *for Steel Industry*

	1977 B	1977 CB	1978 B	1978 CB	1979 B	1979 CB
Demand of basic bricks	104.2	41.3	113.1	41.3	123.3	41.3
Pea Magnesite required for:	145.5		154.4		164.6	
(a) Brick making	101.80		108.00		115.2	
(b) Mortar making	7.3		7.90		8.6	
(c) Ramming making	2.30		2.40		2.5	
(d) Fettling						
Rourkela	1.5		1.5		1.5	
Bhilai	20.0		20.0		20.0	
Durgapur	8.8		8.8		8.8	
ASP	0.5		0.5		0.5	
TATA	4.0		4.0		4.0	
IISCO	2.8		2.8		2.8	
MISCO	2.0		2.0		2.0	
SFAI	14.65		14.65		14.65	
TOTAL	**165.00**		**171.90**		**179.95**	

	1980 B	1980 CB	1981 B	1981 CB	1982 B	1982 CB
Demand of Basic Bricks	133.2	41.3	139.3	41.3	152.9	41.3
	174.5		180.6		194.2	
Pea Magnesite required for:						
(a) Brick Making	122.1		126.4		135.9	
(b) Mortar making	9.3		9.7		10.7	
(c) Ramming making	2.6		2.7		2.8	
(d) Fettling						
Rourkela	1.5		1.5		1.5	
Bhilai	20.0		20.0		20.0	
Durgapur	8.8		8.8		8.8	
ASP	0.5		0.5		0.5	
TATA	4.0		4.0		4.0	
IISCO	2.8		2.8		2.8	
MISCO	2.0		2.0		2.0	
SFAI	14.65		14.65		14.95	
TOTAL	**187.65**		**192.45**		**203.05**	

NOTES:

1. For brick making, mortar and ramming mass one tonne of basic material is assumed to require 700 Kg. of Dead Burnt Magnesite.
2. Mortar requirement has been taken as 10% of burnt basic bricks by weight.

Demand of **DEAD BURNT MAGNESITE** *during* 1971-85 *for Steel Industry*

	1983		1984		1985	
	B	CB	B	CB	B	CB
Demand of Basic Bricks	159.7	41.3	166.8	41.3	172.3	41.3
	201.0		208.1		213.6	
Pea Magnesite required for:						
(a) Brick making	140.7		145.6		149.5	
(b) Mortar making	11.2		11.7		12.0	
(c) Ramming making	2.9		2.9		3.0	
(d) Fettling						
Rourkela	1.5		1.5		1.5	
Bhilai	20.0		20.0		20.0	
Durgapur	8.8		8.8		8.8	
ASP	0.5		0.5		0.5	
TATA	4.0		4.0		4.0	
IISCO	2.8		2.8		2.8	
MISCO	2.0		2.0		2.0	
SFAI	14.65		14.65		14.65	
TOTAL	**208.45**		**213.85**		**218.15**	

NOTES:

1. For brick making, mortar and ramming mass one tonne of basic material is assumed to require 700 Kg. of Dead Burnt magnesite.

ANNEXURE E

ANNEXURE E

Report on re-examined demand of major categories of refractories required by the Steel Industry

A. At the joint meeting of the Panel for Refractory Industry and I.R.M.A. held in Calcutta on the 8th and 9th September, 1971, the draft report prepared by Refractories Committee of Department of Steel pertaining to projected demand of refractories required by steel industry was thoroughly discussed. It was revealed during discussions that the estimates of requirements as projected need scrutiny. It was, therefore, decided that a team should visit all the steel plants and have discussions with the Consultants who had furnished demand figures for new steel projects and the Steel Furnace Association of India who had furnished figures of requirements for Electric Furnaces :

A.2 Accordingly, a team comprising of the following was deputed for the purpose :—

1. Shri S. R. Khana, Development Officer (Refractories), D.G.T.D.	*Convenor*
2. Shri M. H. Dalmia, Orissa Cement Ltd.	*Member*
3. Dr. S. S. Ghose, Belpahar Refractories Ltd.	*Member*
4. Shri J. R. K. Murthy, Harry Refractories Ltd.	*Member*
5. Shri P. S. Sundaram, Superintendent, Refractories, Rourkela Steel Plant.	*Member*
6. Shri S. K. Mukherjee, General Foreman (I & T), HSL, Bhilai Steel Plant.	*Member*
7. Shri I. C. Modi, Durgapur Steel Plant.	*Member*
8. Shri K. S. Swaminathan, Superintendent (Refracotics), Tata Iron & Steel Co. Ltd.	*Member*
9. Shri T. Gupta Roy, Indian Iron & Steel Co. Ltd.	*Member*

A.3 Broad terms of reference of the team were :—

(a) to study and examine the demand pattern of refractories as given in the Draft Report prepared by the Refractories Committee ;

(b) area and quantum of consumption of stiff plastic and dry process fireclay refractories; and

(c) special problems relating to application of specific categories of refractories in selected areas in a steel plant.

A.4 The team visited various steel plants between 4th and 12th October, 1971. The discussions with C.E.D.B. were held at Ranchi on 8th October and with M/s. M. N. Dastoor & Company and Steel Furnace Association of India on 15th and 16th October, 1971 respectively at Calcutta.

A.5 The report on re-examination of requirements of refractories after discussion with concerned authorities is placed below.

I. UNIT : ROURKELA STEEL PLANT—ROURKELA:

Date of Visit : 4-10-1971, 5-10-1971

Discussions with : S/Shri P. S. Sundaram,
Superintendent, Refractories.

K. K. Bandhopadhyaya,
Assistant Superintendent,
Refractories.

1. In accordance with the terms of reference spelt out earlier, the demand pattern of different categories of refractories was re-examined item by item. The revised demand, as agreed upon, is at Annexure F.

2. Areas where there has been substantial difference as compared to the earlier estimates of demand are briefly as under :

(i) *Fireclay :*

(a) Requirements for Open Hearth checkers were revised to 1,000 tonnes as against 2,000 tonnes indicated earlier.

(b) Requirements for High Alumina refractories have been recast.

(c) Requirements for Blast Furnace proper and checkers have been increased on account of revised programme of stoves rebuilding.

(d) Requirements for stoves have been revised.

(e) Demands for Coke Oven checkers and Coke Oven shapes, both for operational and capital requirements, have been increased due to revised programme for repairs and rebuilding of coke oven batteries. Demand of these types has been reduced mainly for operational requirements. The change has come about as a result of recalculation based on the process of manufacture involved.

(f) In the case of Blast Furnace checkers, Coke Oven checkers and shapes and Pouring refractories, the requirements of plastic refractories have been indicated. The Supdt. refractories, after discussion has agreed to carry out trials with stiff plastic refractories for its open hearth checkers.

(ii) *Basic :*

Demand for Burnt Basic, both for operational and capital requirements has been reduced after re-examination and discussions.

(iii) *Silica :*

(a) Fresh requirements for 1972-73 have been given at Annexure-I.

(b) Demand for rebuilding has been revised on account of revised programme for rebuilding.

3. Special problems mentioned by the Refractory Experts relating to application of specific categories of refractories in selected areas of the Unit were—

(i) that Basalt tiles for the Sintering Plant are not indigenously available ;

(ii) that they were finding it difficult to procure mortar of proper quality for recuperator tubes ;

(iii) that difficulty was being experienced for Coke Oven spraying mass—the unit is reported to be trying the indigenously available substitutes ; and

(iv) that in galvanishing line they were feeling handicapped for want of low iron insulating bricks of proper electrical resistivity.

4. *General Observations :*

(a) The unit, after discussion, was prepared to re-examine their requirements of refractories particularly of fire bricks, for which they had already obtained import clearance for thirteen thousand and odd tonnes.

(b) The management is also conscious of carrying stocks of 17,300 tonnes of fireclay refractories.

(c) The Refractory Experts as well as the Management are rather concerned about the availability of coke oven silica bricks and Blast Furnace Stove bricks to keep up with their rebuilding schedule.

II. UNIT : BHILAI STEEL PLANT, BHILAI :

Date of Visit : 6-10-1971, 7-10-1971

Discussions with : Shri P. R. Ahuja,
General Manager.

Sri M. Chandrasekharan,
Asstt. Genl. Superintendent.

Sri B. C. Mathur,
Supdt. (Coke Ovens).

Sri Gajendragadkar,
Refractories Engineer.

Sri S. K. Mukherjee,
General Foreman (I & T).

(1) Revised estimates of requirements of refractories as agreed after discussion are tabulated at Annexure F. Noteworthy variations have been in the following categories of refractories :—

(i) *Fireclay :*

(a) The unit has projected fresh demand for coke oven shapes and checkers on account of rebuilding/ repair programme not visualised earlier.

(b) Demand for blast furnace refractories has been changed due to their repair schedule. In their case Blast furnace refractories include their requirements for checkers and stoves because of similarity of shapes.

(c) Requirements of Open Hearth checkers has been revised from 1975 onwards as the Expansion will be by LD Process.

(d) Stiff plastic refractoties are to be used for coke oven checkers, shapes as well as in reheating furnaces. They will also be using these refractories in Blast Furnace Ladles till 1974, and meet a part of their requirements for Open Hearth checkers.

(ii) *Basic :*

(a) There is change in the demand for Burnt basic refractories from 1975 onwards as a result of expansion to be carried out by LD Process.

(b) Fresh demand for Tar Bonded Dolomite refractories for LD Convertors has been projected now.

(iii) *Silica :*

(a) They have projected fresh demand for coke oven rebuilding and repairs.

(b) Demand for silica refractories other than coke oven has been revised from 1975 onwards since Expansion will be by LD Process.

2. Problems as brought about by the Management were discussed quite at length. These are—

(a) Non-availability of well-blocks in required quantities—Chemically bonded well-blocks to take care of their very stringent size tolerance were suggested—Bhilai is experimenting with them.

(b) Non-availability of sleeves of proper quality—according to the Management—sleeves from some sources are failing in service performance.

(c) Non-availability of special shapes roof bricks (half thickness)—alternative sizes have been proposed to take care of manufacturing difficulties—Bhilai team agreed to try out the alternative sizes.

(d) For items like burner blocks required, in small quantities there appear to be general reluctance on the part of refractory manufacturers to supply such refractories.

(e) Shortage of magnesite pea—It was explained by the team that the situation would improve when the second rotary kiln of Messrs Dalmia Magnesite Corporation, Salem, is commissioned and also there is availability of Almora magnesite from Belpahar Refractories Limited.

(f) Limited availability of arch bricks and forsite bricks—It was felt that this situation would continue for some time more till the manufacturers install balancing equipment.

(g) Non-availability in required quantities of blast furnace—Ladle bricks produced by wet process of proper size tolerances—The matter needs further probing in consultation with the manufacturers of stiff plastic refractories.

3. *General Observations :*

(i) The Management expressed that they were in desperate need of 2,000 tonnes of coke oven silica bricks for rebuilding.

(ii) The unit is in a happy position with their stock of fireclay and basic refractories.

(iii) The estimates of requirements for their constructional programme for Expansion from 2.5 to 4/4.2 million tonnes expected to be completed by 1976 have not been taken into account in the estimates of demand.

(iv) The licence already in hand for 11,370 tonnes for fireclay refractories has been surrendered.

III(a). UNIT : CENTRAL ENGINEERING AND DESIGNS BUREAU HINDUSTAN STEEL LIMITED, RANCHI:

Date of Visit : 8-10-1971

Discussions with : Sri T. R. Anantaraman,
Superintendent, Refractories.

Sri N. S. Murdeswar,
Senior Designer.

The team was informed that CEDB had worked out constructional and operational requirements of refractories of Bhilai Expansion, Hospet and other new Steel Projects. In reply to a query relating to norms taken for the said requirements, it was explained that they had estimated the requirements on the pattern adopted for Bokaro Steel Plant. In this context, it was decided that a representative of CEDB should accompany the Team to Bokaro Steel Plant and clarify the doubts expressed particularly with regard to norms of 30 kg. per tonne taken for fireclay refractories. Sri Murdeswar, accordingly, accompanied the Team to Bokaro.

III(b). UNIT : BOKARO STEEL PLANT, BOKARO STEEL CITY:

Date of Visit 9-10-1971

Discussions with : Sri D. Chibber,
Superintending Engineer.

Sri Y. K. Budhiraj,
Purchase Officer.

1. Sri M. S. Lal, General Manager (Construction), in his opening remarks while addressing the Team, mentioned that the estimated requirements for construction were based on the norms indicated in the Detailed Project Report prepared by their collaborators. In the absence of any other authentic reference, it was decided to take the requirements for construction and operation on the norms adopted in the Detailed Project Report. The Team, however, went into the schedule of construction and grouped various categories of refractories to be in line with the pattern adopted for the availability.

2. The noteworthy feature was that the operational norms for fireclay refractories taken at 30 kg per tonne by CEDB was in actual effect 24.6 kg/tonne. CEDB representative agreed to the same norm being taken for the new steel projects also. Table at Annexure F is based on the above observations.

3. Problems faced by Bokaro Steel Ltd., largely related to procurement of various types of refractories from indigenous sources ; in particular, mention was made of pouring refractories, viz., sleeves, clay graphite stopperheads. They also indicated restricted quotations received for recuperator tubes, coke oven checkers for their third and fourth batteries and coke oven doors. They were also not happy with supplies not being in conformity with agreed delivery schedule.

4. *General Observations* :

   (a) Refractories imported from Russia are being in accordance with specifications laid down, and it was reported that there had been rejections which are likely to be replaced free of cost.

   (b) Bokaro Steel Plant's imports on account of construction have been excluded from these estimates of demand because these requirements would not be secured from indigenous sources.

   (c) For construction of new steel plants, basic demands have been taken under the Burnt Basic group.

   (d) CEDB confirmed that for Bhilai Expansion, coke oven refractories would not be required as no further coke oven construction is envisaged.

   (e) For the new steel plants, the basis will be same as for Bokaro plus 6 kg. under high grog for tundish (in case of continuous casting only) and minus 2½ kg. for soaking pits and reheating furnaces.

IV. UNIT : TATA IRON AND STEEL CO. LTD., JAMSHEDPUR :

Date of Visit : 10-10-1971

Discussions with : Sri K. S. Swaminathan,
Supdt., Refractories.

Sri B. Rao,
Asstt. Supdt.,
Refractories.

Sri M. Swaminathan,
General Foreman.

1. It is an old unit. Consumption norms for certain operational requirements are on the high side on account of the process followed for manufacture of steel which involves additional handling of liquid metal. Projected demand is at Annexure F.

2. Based on their past experience, they have changed to dry process bricks in ladle since last two years.

3. It is to be noted that they have revised their requirements for stiff plastic refractories which is around 25% of the total requirements for fireclay refractories as against 10/15% in the case of other steel plants.

4. Major areas where they use stiff plastic refractories are Open Hearth checkers and normal bricks for other operational jobs.

Problems faced by this Unit are as follows :—

(a) They are finding difficulty in the procurement of suitable quality of stopperhead and nozzles, particularly for the bigger capacity ladles.

(b) On account of the present design of their blast furnace stoves, they have to use Superex blocks which they are not able to procure from any indigenous sources.

(c) For the maintenance of coke ovens, they have to depend on imports for ONX and Mateorite used as patching compound and Neurokitt employed as spraying compound.

(d) They have not been able to locate indigenous source for Basalt tiles required for sintering plant dust catcher cyclones.

(e) Their experience with basic bricks used as substitute for fused Corhart refractories in the Rehearing furnace Bottoms has not been satisfactory. They are now planning to use imported Corhart refractories for lining of the reheating furnace bottoms.

(f) As in the case of other Units, they are also facing shortage of dead burnt magnesite for fettling. The shortfall is around 2,000 tonnes.

(g) The Unit has planned for palletisation of refractories received at their Works. They, accordingly feel that the supplies should also be made in pellets to synchronise with their proposed system.

(5) *General Observations :*

(a) They have well organised their sources of supply of various types of refractories and, hence, comparatively speaking, they do not face difficulty in procurement.

(b) They are obtaining nearly 70% of their requirements from units other than M/s Belapahar Refractories their associate concern.

V. UNIT : DURGAPUR STEEL PLANT, DURGAPUR :

Date of Visit : 11-10-1971

Discussions with : Sri Mathews,
Asstt. General Superintendent,
Refractories.

Sri D. J. J. Rao,
Superintendent,
Refractories.

1. Requirements of refractories in general were on the high side on account of conditions prevailing at Durgapur. Their projected demands based on the discussions and past consumption are at Annexure F.

2. Major areas of difference between their original demand and now projected are for steel ladles, open hearth checkers and other firebricks as also in their Basic Bricks requirements.

3. They are using stiff plastic refractories for blast furnace ladles, and a part of their requirements for open hearth checkers, coke oven checkers, soaking pits, coke oven shapes, reheating furnaces and pouring.

4. Problems faced by this Unit are as follows :

(a) They reported that indigenous producers were not able to meet the specifications, nor do they stick to agreed delivery schedule in the case of stiff plastic refractories.

(b) Non-availability of magnesite bricks was being felt.

(c) Their demand for sillimanite quality recuperator tubes was not being satisfactorily met from indigenous sources.

(d) Indigenous manufacturers were not responding to their demand for high alumina bricks for Open hearth furnaces.

(e) Calandum, a substitute for cement fondu, had not proved successful.

(f) It was claimed that Detrick bricks for the open hearth Uptake could be procured from only one source. Suggestion made by the Unit was to develop an alternative source of supply. The same suggestion was made for bottom pouring refractories as well as for stopperheads.

(g) High alumina ramming mass for the reheating furnace was not available indigenously and this item should therefore be developed indigenously.

(h) They preferred to have delivery of various types of refractories in sets instead of present practice of supply in piece-meal.

VI. UNIT : ALLOY STEEL PLANT, DURGAPUR:

Date of discussion : 11-10-1971 (Durgapur)
15-10-1971 (Calcutta).

Discussions with : Sri S. V. Raman at Durgapur.

Dr. G. Mukherjee, Sri I. B. Banerjee } in Calcutta

1. Preliminary discussions were held on the 11th October, 1971, at Durgapur in the presence of Sri S. V. Raman, General Superintendent, who joined recently. As they were not prepared for detailed discussions, their representatives were advised to come to Calcutta on the 15th October, 1971 for discussions with the Team. Accordingly, Dr. G. Mukherjee, Assistant General Superintendent, and Sri I.B. Banjerjee, Refractories Engineer, discussed their requirements with the Team on 15th October. Their projected demand is at Annxure F.

2. Stiff plastic refractories are used by the Unit in Reheating furnace and pouring.

3. Problems faced by this Unit are as follows :

(a) They informed that they were finding difficulty in procuring bloating nozzles from indigenous, sources specially for their 50-ton furnace and for critical grades even in 12-ton furnace.

(b) They were not satisfied with indigenously procured clay graphite sopperheads.

(c) High alumina (94% Al_2O_3) (for Vacuum De-gassing) need to be developed in the country.

(d) They were finding difficulty in obtaining their requirements of high alumina bricks 85% (alumina) but were advised to try sources other than those they depended upon.

(e) According to them, life of silicon carbide through for electrical soaking pits was not more than six months as against two years that could be had from imported material.

(f) They suggested that a study be conducted regarding cracking of bricks prematurely when gas fired furnaces are switched over to oil firing.

VII. UNIT : INDIAN IRON AND STEEL CO. LTD., BURNPUR :

Date of Visit : 12-10-1971

Discussions with : Sri T. Gupta Roy.
Sri I. B. Banerjee.

1. It is an old established Unit. It is mainly using refractories manufactured by stiff plastic process. Their projected demands are at Annexure F.

2. Areas where stiff plastic refractories are being used are steel ladles, blast furnace checkers and proper stoves, reheating furnace and pouring refractories.

3. Problems faced by this Unit are as follows :

(a) They were not getting stopperheads in adequate quantity. The only indigenous supplier, though having a satisfactory quality, has limited capacity. Hence, there is a need to develop alternative sources of supply of stopperheads.

(b) They were not satisfied with the substitute indigenously developed for cement fondu.

(c) As in the case of others they were facing shortage of wagons for obtaining their requirements of refractories.

(d) The Unit had a bad experience in regard to breakage of refractories in transit and as such, suggested for improved methods of a packing to be adopted by the Refractory Industry.

(e) They were also feeling shortage of basic bricks.

4. *General Observations :*

IISCO has got an associate unit manufacturing various types of refractories. It was revealed, during discussions, that 90% of their requirements for firebricks, 85% of silica requirements and 75% of basic requirements are being met by their associate concern.

VIII. UNIT : MYSORE IRON & STEEL CO. LTD., BHADRAVATI :

Date of discussion: : 15-10-1971 in Calcutta.

Discussions with : Sri Devraj Mudaliar,
Regional Manager,
(Refractories).

1. Sri Mudaliar explained that they were manufacturing firebricks having a capacity of 9,600 tonnes per annum, of which 6,000 tonnes are by wet process and the remaining 3,600 tonnes by dry process. They were getting their requirements of firebricks from their own unit, with the exception of high alumina (above 35%) from other indigenous sources. Accordingly, the figures regarding availability and demand of firebricks have not been taken into account in their case.

2. Table indicating their high alumina, basic and silica requirements as projected and agreed to is at Annexure F.

3. The only problem brought forward by Sri Mudaliar was that they were finding it difficult to procure magnesite bricks from indigenous sources.

ANNEXURE F

ALLOY STEEL PLANT, DURGAPUR

(for the years 1971 to 1980)

(*Operational & Capital repairs requirements from* 1971 *to* 1980)

(In '000 tonnes)

		1971				1972			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonnes)		..	..	0·1	..	..	0·1	..	..
Fireclay and high alumina bricks :									
Ladles : Steel	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	1·5	1·5	..	..	1·5	1·5
BF & Others	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
OH Checkers	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
BF Checkers	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
CO Checkers	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
Soaking Pits	Op.	..	..	..	..	..	..	..	..
Covers	Cap.	..	..	..	..	..	..	..	..
Blast Furnance : Hearth	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
Proper : Bosh	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
Inwall	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
Stoves & Others	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
Coke Oven	Op.	..	..	..	..	..	..	..	..
Shapes	Cap.	..	..	..	..	..	..	..	..
Others :	Op./Cap	0·3	..	0·6	6·0	0·3	..	0·6	6·0
Pouring :	Op./Cap.	..	..	..	0·8	..	..	..	0·9
	TOTAL	0·3	..	2·1	8·3	0·3	0·1	2·1	8·4

ALLOY STEELS PLANT, DURGAPUR

(Operational & Capital repairs requirements from 1971 *to* 1980)

(In '000 tonnes)

		1973				1974			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonnes)		..	0·1	..	..	..	0·1	..	..
Fireclay and high alumina bricks									
Ladles : Steel	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	1·5	1·5	..	..	1·5	1·5
BF & Others :	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
OH Checkers	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
BF Checkers	Op.	..	..	..	..	..	..	..	..
	Cap.								
CO Checkers	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
Soaking Pits	Op.	..	..	..	..	..	..	..	..
Covers	Cap.	..	..	..	..	..	..	..	..
Blast Furnace : Hearth	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
Proper : Bosh	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
Inwall	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
Stoves & Others	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
Coke Oven	Op.	..	..	..	..	..	..	..	..
Shapes	Cap.	..	..	..	..	..	..	..	..
Others :	Op./Cap.	0·3		0·6	6·6	0·3	..	0·6	6·0
Pouring :	Op./Cap.	..	..	..	0·9	..	..	..	0·9
	TOTAL	0·3	..	2·1	8·4	0·3	..	2·1	8·4

ALLOY STEELS PLANT, DURGAPUR

(*Operational & Capital repairs requirements from* 1971 *to* 1980)

(In '000 tonnes)

		1975				1976			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million tonnes)		..	..	0·1	..	..	..	0·1	..
Fireclay and high alumina bricks :									
Ladles : Steel	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	1·5	1·5	..	..	1·5	1·5
BF & Others :	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..		..	..	..	..	..
OH Checkers	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
BF Checkers	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
CO Checkers	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
Soaking Pits	Op.	..	..	..	..	..	..	..	..
Covers	Cap.	..	..	..	..	..	..	..	..
Blast Furnance : Hearth	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
Proper : Bosh	Op.	..	..	..	..	...	..	..	..
	Cap.	..	..	..	..	..	..	..	..
Inwall	Op.	..	..	..	..	..	..	..	..
	Cap.								
Stoves & Others	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	...	..	..	..
Coke Oven	Op.	..	..	..	..	..	..	..	..
Shapes	Cap.	..	..	..	..	..	..	..	..
Others :	Op./Cap.	0·3	..	0·6	6·0	0·35	..	0·6	6·0
Pouring :	Op./Cap.	..	..	..	0·9	..	..	..	0·9
	TOTAL	0·3	..	2·1	8·4	0·35	..	2·1	8·4

ALLOY STEELS PLANT, DURGAPUR

(*Operational & Capital repairs requirements from* 1971 *to* 1980)

(In '000 tonnes)

		1977				1978			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonnes)		..	0·1	..	..	..	..	0·1	..
Fireclay and high alumina bricks :									
Ladles : Steel	Op.	..	..	1·5	1·5	..	..	1·5	1·5
	Cap.	..	..	..	..	..	..	..	..
BF & Others	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
OH Checkers	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
BF Checkers	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
CO Checkers	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
Soaking Pits	Op.	..	..	..		..	..	..	..
Covers	Cap.	..	..	..	..	..	..	..	
Blast Furnace Hearth	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
Proper : Bosh	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
Inwall	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
Stoves and others	Op.	..	..	..	..	..	..	..	..
Coke Oven	Cap.	..	..	..	..	..	..	..	..
Shapes	Cap.	..	..	..	..	..	..	..	..
Others	Op.	..	..	..	..	..	..	..	..
	Cap.	0·35	..	0·6	6·0	0·35	..	0·6	6·0
Pouring	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	0·9	..	..	..	0·9
	TOTAL	0·35	..	2·1	8·4	0·35	..	2·1	8·4

ALLOY STEELS PLANT, DURGAPUR

(*Operational & Capital repairs requirements from* 1971 *to* 1980)

(In '000 tonnes)

		1979				1980			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonnes)		..	..	0·1	..	..	0·1	..	..
Fireclay and high alumina bricks :									
Ladles : Steel	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	1.5	1.5	..	..	1.5	1·5
BF & Others	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
OH Checkers	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
BF Checkers	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
CO Checkers	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
Soaking Pits	Op.	..	..	..	..	..	..	..	..
Covers	Cap.	..	..	..	..	..	..	..	..
Blast Furnace Hearth	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
Proper : Bosh	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
Inwall	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
Stoves and others	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
Coke Oven	Op.	..	..	..	..	..	..	..	..
Shapes	Cap.	..	..	..	..	..	..	..	..
Others	Op.	..	..	..	..	..	..	..	..
	Cap.	0·35	..	0·6	6·0	0·35	..	0·6	6·0
Pouring	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	0·9	..	..	..	0·9
	TOTAL	0·35	..	2·1	8·4	0·35	..	2·1	8·4

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ALLOY STEELS PLANT, DURGAPUR

(*Operational & Capital repairs requirements from* 1971 *to* 1980)

(In '000 tonnes)

	1971	1972	1973	1974	1975
STEEL INGOT PRODUCTION (In Million Tonnes)	0·1	0·1	0·1	0·1	0·1
BASIC :					
Burnt (a) Operational (b) Capital (c) Construction	1·0	1·0	1·0	1·0	1·0
Chemically bonded : (a) Operational (b) Capital (c) Construction	1·5	1·5	1·5	1·5	1·5
TOTAL	**2·5**	**2·5**	**2·5**	**2·5**	**2·5**
Dead burnt magnesite : Operational	0·5	0·5	0·5	0·5	0·5
Basic Ramming Mass	1·1	1·1	1·1	1·1	1·1
TOTAL	**1·6**	**1·6**	**1·6**	**1·6**	**1·6**

	1976	1977	1978	1979	1980
STEEL INGOT PRODUCTION (In Million Tonnes)	0·1	0·1	0·1	0·1	0·1
BASIC :					
Burnt (a) Operational (b) Capital (c) Construction	1·0	1·0	1·0	1·0	1·0
Chemically bonded : (a) Operational (b) Capital (c) Construction	1·5	1·5	1·5	1·5	1·5
TOTAL	**2·5**	**2·5**	**2·5**	**2·5**	**2·5**
Dead burnt magnesite : Operational	0·5	0·5	0·5	0·5	0·5
Basic Ramming Mass	1·1	1·1	1·1	1·1	1·1
TOTAL	**1·6**	**1·6**	**1·6**	**1·6**	**1·6**

ALLOY STEELS PLANT, DURGAPUR

(Operational & Capital repairs requirements from 1971 *to* 1980)

(In '000 tonnes)

		1971	1972	1973	1974	1975
SILICA :						
Coke Ovens :	(a) Repairs (b) Re-built (Cap) (c) New Construction	..	..	..	..	..
Roof :	(a) Repairs (b) Re-built (Cap.) (c) Construction	0·7	0·7	0·7	0·7	0·7
Converters :						
Others :	(a) Repairs (b) Re-built (Cap.) (c) New Construction	0·2	0·2	0·2	0·2	0·2
	TOTAL	**0·9**	**0·9**	**0·9**	**0·9**	**0·**

		1976	1977	1978	1979	1980
SILICA :						
Coke ovens :	(a) Repairs (b) Re-built (Cap.) (c) New Construction	..	..	..	..	..
Roof :	(a) Repairs (b) Re-built (Cap.) (c) New Construction	0·7	0·7	0·7	0·7	0·7
Converters :						
Others :	(a) Repairs (b) Re-built (Cap.) (c) New Construction	0·2	0·2	0·2	0·2	0·2
	TOTAL	**0·9**	**0·9**	**0·9**	**0·9**	**0·9**

BHILAI STEEL PLANT, BHILAI

(*Operational & Capital repairs requirements from* 1971 *to* 1980)

(In '000 tonnes)

		1971				1972			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonnes)		..	2·2	..	..	..	..	2·4	..
Fireclay and high alumina bricks :									
Ladles : Steel	Op.	..	18·3	..	..	..	19·9	..	..
BF & Others	Op.	..	..	..	3·7	..	..	..	4·3
OH Checkers	Op.	..	2·8	..	6·0	..	3·2	..	6·4
CO Checkers	Op.	..	..	..	..	..	..	..	0·7
Soaking Pit Covers	Op.	..	1·8	..	..	..	1·9	..	..
Blast Furnace Proper including Checkers & Stoves	Op.	..	4·7	..	..	..	2·8	..	..
Coke Oven Straights	Op.	..	..	..	..	..	..	..	0·1
Coke Oven Shapes	Op.	..	..	..	..	..	..	..	1·5
Others	Op.	0·2	..	..	20·0	0·2	..	..	21·8
Pouring	Op.	..	..	..	4·8	..	..	..	5·3
TOTAL		0·2	27·6	..	34·5	0·2	27·8	..	40·2

		1973				1974			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonnes)		..	..	2·5	..	..	2·5	..	..
Fireclay and high alumina bricks :									
Ladles : Steel	Op.	..	20·8	..	..	..	20·8	..	..
BF & Others	Op.	..	..	..	4·3	..	..	5·0	..
OH Checkers	Op.	..	3·5	..	6·5	..	3·5	..	6·5
CO Checkers	Op.	..	..	..	2·0	..	..	..	0·7
Soaking Pit Covers	Op.	..	2·0	..	..	..	2·0	..	..
Blast Furnace Proper including Checkers & Stoves	Op.	..	4·6	..	..	..	4·3	..	..
Coke Oven Straights	Op.	..	..	..	1·5	..	..	..	0·4
Coke Oven Shapes	Op.	..	...	..	3·9	..	..	..	1·5
Others	Op.	0·2	..	..	22·7	0·2	..	..	22·7
Pouring	Op.	..	..	..	5·5	..	..	..	5·5
TOTAL		0·2	30·9	...	46·4	0·2	30·6	5·0	37·3

BHILAI STEEL PLANT, BHILAI

(*Operational & Capital repairs requirements from* 1971 *to* 1980)

(In '000 tonnes)

		1975				1976			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonnes)		..	..	3·0	..	..	3·4	..	..
Fireclay and high alumina bricks :									
Ladles : Steel	Op.	..	24·9	..	..	..	28·2	..	..
BF & Others	Op.	..	..	5·1	..	..	..	5·8	..
OH Checkers	Op.	..	3·5	..	6·5	..	3·5	..	6·5
CO Checkers	Op.	..	..	..	0·7	..	..	..	0·7
Soaking Pit Covers	Op.	..	2·0	..	..	..	2·0	..	..
Blast Furnace Proper including Checkers & Stoves	Op.	..	7·2	..	..	..	6·8	..	..
Coke Oven Straights	Op.	..	..	..	0·4	..	..	..	0·4
Coke Oven Shapes	Op.	..	..	..	2·5	..	..	..	2·5
Others	Op.	1·3	..	..	23·5	1·3	..	..	24·2
Pouring	Op.	..	..	..	6·6	..	..	..	7·5
TOTAL		1·3	37·6	5·1	40·2	1·3	40·5	5·8	41·8

		1977				1978			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonnes)		..	3·6	..	..	..	3·8	..	..
Fireclay and high alumina bricks :									
Ladles : Steel	Op.	..	29·9	..	..	..	31·5	..	..
BF & Others	Op.	..	..	6·1	..	..	..	6·5	..
OH Checkers	Op.	..	3·5	..	6·5	..	3·5	..	6·5
CO Checkers	Op.	..	..	..	0·7	..	..	..	0·7
Soaking Pit Covers	Op.	..	2·0	..	..	..	2·0	..	..
Blast Furnace Proper including Checkers & Stoves	Op.	..	6·8	..	..	..	6·8	..	..
Coke Oven Straights	Op.	..	..	..	0·4	..	..	..	0·4
Coke Oven Shapes	Op.	..	..	..	1·5	..	..	..	1·5
Others	Op.	1·3	..	..	24·5	1·8	..	..	24·9
Pouring	Op.	..	..	..	7·9	..	..	..	8·4
TOTAL		1·3	42·2	6·1	41·5	1·8	43·8	6·5	42·4

BHILAI STEEL PLANT, BHILAI

(*Operational & Capital repairs requirements from* 1971 *to* 1980)

(In '000 tonnes)

		1979				1980			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonnes)		..	4·0	..	..	..	4·0	..	..
Fireclay and high alumina bricks :									
Ladles : Steel	Op.	..	33·2	..	..	..	33·2	..	..
BF & Others	Op.	..	..	6·8	..	..	..	6·8	..
O.H. Checkers	Op.	..	3·5	..	6·5	..	3·5	..	6·5
C.O. Checkers	Op.	..	..	..	0·7	..	..	..	0·7
Soaking Pit Covers	Op.	..	2·0	..	..	..	2·0	..	..
Blast Furnace Proper including Checkers & Stoves	Op.	..	6·8	..	..	..	6·8	..	..
Coke Oven Straights	Op.	..	..	..	0·4	..	..	..	0·4
Coke Oven Shapes	Op.	..	..	..	1·5	..	..	..	1·5
Others	Op.	2·0	..	..	25·2	2·0	..	..	25·2
Pouring	Op.	..	..	..	8·8	..	..	..	8·8
TOTAL	Op.	2·0	45·5	6·8	43·1	2·0	45·5	6·8	43·1

BHILAI STEEL PLANT, BHILAI

(*Operational & Capital repairs requirements from* 1971 *to* 1980)

(In '000 tonnes)

	1971	1972	1973	1974	1975
STEEL INGOT PRODUCTION (In Million Tonnes)	2.2	2.4	2.5	2.5	3.0
basic :					
Burnt : Operational	29.8	32.5	33.9	33.9	33.9
Chemically bonded : Operational	12.1	13.2	13.8	13.8	13.8
TOTAL	41.9	45.7	47.7	47.7	47.7
Dead Burnt Magnesite : Operational	13.2	19.2	20.0	20.0	20.0
Tar Bonded Dolomite : Operational	..	..	..	..	6.5

	1976	1977	1978	1979	1980
STEEL INGOT PRODUCTION (In Million Tonnes)	3.4	3.6	3.8	4.0	4.0
basic :					
Burnt : Operational	34.0	34.0	34.0	34.0	34.0
Chemically bonded : Operational	13.8	13.8	13.8	13.8	13.8
TOTAL	**47.8**	**47.8**	**47.8**	**47.8**	**47.8**
Dead Burnt Magnesite : Operational	20.0	20.0	20.0	20.0	20.0
Tar Bonded Dolomite : Operational	11.7	14.3	16.9	19.5	19.5

BHILAI STEEL PLANT, BHILAI

(*Operational & Capital repairs requirements from* 1971 *to* 1980)

(In '000 tonne)

	1971	1972	1973	1974	1975
Silica :					
Coke Oven : Operational	2.0	9.4	8.0	3.5	3.5
Roof, Converters, Others } Operational	7.9	7.9	7.9	7.9	7.9
TOTAL	**9.9**	**17.3**	**15.9**	**11.4**	**11.4**

	1976	1977	1978	1979	1980
Silica :					
Coke Oven : Operational	3.5	3.5	3.5	3.5	3.5
Roof, Converters, Others } Operational	7.9	7.9	7.9	7.9	7.9
TOTAL	**11.4**	**11.4**	**11.4**	**11.4**	**11.4**

DURGAPUR STEEL PLANT, DURGAPUR

(*Operational Capital repairs requirements from* 1971 *to* 1980)

(In '000 tonnes)

		1971				1972			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonne)		..	..	1.15	..	..	..	1.3	..
Fireclay and high alumina bricks :									
Ladles : Steel	Op.	..	..	16.0	..	..	..	19.1	..
BF & Others	Op.	..	..	..	6.8	..	..	..	7.7
O.H. Checkers	Op.	..	..	3.1	1.5	..	..	3.5	1.7
	Cap.	..	..	..	..	..	..	..	..
B.F. Checkers	Op.	..	0.4	2.1	..	..	0.8	3.7	..
	Cap.	..	..	..	..	..	..	..	..
CO Checkers	Op.	..	..	..	0.2	..	..	..	0.2
	Cap.	..	..	..	..	..	..	..	..
Soaking Pit Covers	Op.	..	..	..	1.3	..	..	..	1.4
Covers	Cap.	..	..	..	..	..	..	..	..
Blast Furnace	Op.	..	2.4	..	0.5	..	2.3	..	0.4
Proper	Cap.	..	..	..	..	..	..	..	..
Stoves & others	Op.	..	0.5	7.0	..	..	1.0	14.5	..
	Cap.	..	..	..	..	..	..	..	..
Coke Oven	Op.	..	..	..	0.2	..	..	..	0.2
Shapes	Cap.	..	..	..	..	..	..	..	..
Others	Op.	0.7	..	..	4.8	0.8	..	..	5.5
	Cap.	..	..	..	..	..	..	..	..
Pouring	Op.	..	..	..	2.3	..	..	..	2.6
TOTAL		0.7	3.3	28.2	17.6	0.8	4.1	40.8	19.7

DURGAPUR STEEL PLANT, DURGAPUR

(*Operational & Capital repairs requirements from* 1971 *to* 1980)

(In '000 tonnes)

		1973				1974			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonne)		..	..	1.45	..	..	..	1.6	..
Fireclay and high alumina bricks :									
Ladles : Steel	Op.	..	..	21.3	..	..	..	23.5	..
BF & Others	Op.	..	..	..	8.6	..	..	..	9.4
O.H. Checkers	Op.	..	..	3.9	1.9	..	..	4.3	2.1
	Cap.	..	..	..	..	..	..	..	..
B.F. Checkers	Op.	..	..	..	..	..	0.4	1.9	..
	Cap.	..	..	..	..	..	..	..	..
CO Checkers	Op.	..	..	..	0.2	..	..	..	0.2
	Cap.	..	..	..	..	..	..	..	1.3
Soaking Pit	Op.	..	..	..	1.5	..	..	..	1.8
Covers	Cap.	..	..	..	..	..	..	..	..
Blast Furnace	Op.	..	..	..	..	..	..	..	..
Proper	Cap.	..	..	..	..	..	2.3	..	0.4
Stoves & others	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	0.5	7·2	..
Coke Oven	Op.	..	..	..	0.2	..	..	..	0.2
Shapes	Cap.	..	..	..	..	..	..	..	4.8
Others	Op.	0.9	..	..	6.1	1.0	..	..	6.7
	Cap.	..	..	..	..	..	..	..	..
Pouring	Op.	..	..	..	2.9	..	..	..	3.2
TOTAL		**0.9**	..	**25.2**	**21.4**	**1.0**	**3.2**	**36.9**	**30.1**

DURGAPUR STEEL PLANT, DURGAPUR

(*Operational & Capital repairs requirements from* 1971 *to* 1980)

(In '000 tonne)

		1975				1976			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonne)		..	..	1.6	..	..	1.6	..	..
Fireclay and high alumina bricks :									
Ladles : Steel	Op.	..	..	23.5	..	..	..	23.5	..
BF & Others	Op.	..	..	..	9.4	..	..	..	9.4
O.H. Checkers	Op.	..	..	4.3	2.1	..	..	4.3	2.1
	Cap.	..	..	..	..	..	..	..	..
B.F. Checkers	Op.	..	..	..	..	..	..	..	..
	Cap.	..	0.4	2.1	..	..	0.4	1.9	..
CO Checkers	Op.	..	..	..	0.2	..	..	..	0.2
	Cap.	..	..	..	..	..	..	..	..
Soaking Pit	Op.	..	..	..	1.8	..	..	..	1.8
Covers	Cap.	..	..	..	..	..	..	..	..
Blast Furnace	Op.	..	..	..	..	..	..	..	..
Proper	Cap.	..	2.4	..	0·5	..	2.3	..	0.4
Stoves & others	Op.	..	..	..	..	..	..	..	..
	Cap.	..	0.5	7.0	..	..	0.5	7.2	..
Coke Oven	Op.	..	..	..	0·2	..	..	..	0.2
Shapes	Cap.	..	..	..	..	..	..	..	..
Others	Op.	1.0	..	..	6.7	1.0	..	..	6.7
	Cap.	..	..	..	..	..	..	..	..
Pouring	Op.	..	..	..	3.2	..	..	..	3.2
TOTAL		**1.0**	**3.3**	**36.9**	**24.1**	**1.0**	**3.2**	**36.9**	**24.0**

DURGAPUR STEEL PLANT, DURGAPUR

(*Operational Capital repairs requirements from* 1971 *to* 1980)

(In '000 tonne)

		1977				1978			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonne)		..	1.6	..	..	..	..	1.6	..
Fireclay and high alumina bricks :									
Ladles : Steel	Op.	..	..	23.5	..	..	..	23.5	..
BF & others	Op.	..	..	..	9.4	..	..	..	9.4
OH Checkers	Op.	..	..	4.3	2.1	..	..	4.3	2.1
	Cap.	..	..	..	..	..	..	..	..
BF Checkers	Op.	..	..	..	..	..	..	..	..
	Cap.	..	0·4	1.9	..	..	0.4	1.9	..
CO Checkers	Op.	..	..	..	0.2	..	..	..	..
	Cap.	..	..	..	1.3	..	..	..	..
Soaking Pit	Op.	..	..	..	1.8	..	..	..	1.8
Covers	Cap.	..	..	..	..	..	..	..	..
Blast Furnace	Op.	..	..	..	..	..	..	..	..
Proper	Cap.	..	2.3	..	0.4	..	2.3	..	0.4
Stoves & others	Op.	..	..	..	..	..	..	..	..
	Cap.	..	0.5	7.2	..	..	0.5	7.2	..
Coke Oven	Op.	..	..	..	0.2	..	..	..	..
Shapes	Cap.	..	..	..	4.8	..	..	..	..
Others	Op.	1·0	..	..	6.7	1.0	..	..	6.7
	Cap.	..	..	..	..	..	..	..	..
Pouring	Op.	..	..	..	3.2	..	..	..	3.2
TOTAL		**1.0**	**3.2**	**36.9**	**30.1**	**1.0**	**3.2**	**36.9**	**23.6**

DURGAPUR STEEL PLANT, DURGAPUR

(*Operational & Capital repairs requirements from* 1971 *to* 1980)

(In '000 tonne)

		1979				1980			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonne)		..	1.6	..	..	..	..	1.6	..
Fireclay and high alumina bricks :									
Ladles : Steel	Op.	..	..	23.5	..	..	..	23.5	..
BF & Others	Op.	..	..	..	9.4	..	..	..	9.4
OH Checkers	Op.	..	..	4.3	2.1	..	..	4.3	2.1
	Cap.	..	..	..	..	..	..	..	..
BF Checkers	Op.	..	..	..	..	..	..	..	..
	Cap.	..	0.4	2.1	..	..	0.4	1.9	..
CO Checkers	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	..	..
Soaking pit	Op.	..	..	..	1.8	..	..	..	1.8
Covers	Cap.	..	..	..	..	..	..	..	..
Blast Furnace	Op.	..	..	..	..	..	..	..	..
Proper	Cap.	..	2.4	..	0.4	..	2.3	..	0.4
Stoves & others	Op.	..	0.5	7.0	..	..	0.5	7.2	..
	Cap.	..	..	..	..	..	..	..	..
Coke Oven	Op.	..	..	..	..	..	..	..	..
Shapes	Cap.	..	..	..	..	..	..	..	..
Others	Op.	1.0	..	..	6.7	1.0	..	..	6.7
	Cap.	..	..	..	..	..	..	..	..
Pouring	Op.	..	..	..	3.2	..	..	..	3.2
TOTAL		1.0	3.3	36.9	23.6	1.0	3.2	36.9	23.6

DURGAPUR STEEL PLANT, DURGAPUR

(*Operational Capital requirements from* 1971 *to* 1980)

(In '000 tonnes)

		1971	1972	1973	1974	1975
STEEL INGOT PRODUCTION (In Million Tonnes)		1.15	1.3	1.45	1.6	1.6
Basic						
Burnt	Op.	4.3	5.0	5.5	6.0	6.0
	Cap.	..	..	..	..	..
Chemically Bonded	Op.	13.0	14.5	16.3	18.0	18.0
	Cap.	..	..	..	..	..
TOTAL		**17.3**	**19.5**	**21.8**	**24.0**	**24.0**
Dead Burnt Magnesite	Op.	6.5	7.4	8.1	8.8	8.8
Basic Ramming Mass	Op.	..	..	..	..	..
TOTAL		**6.5**	**7.4**	**8.1**	**8.8**	**8.8**

		1976	1977	1978	1979	1980
STEEL INGOT PRODUCTION (In Million Tonnes)		1.6	1.6	1.6	1.6	1.6
Basic :						
Burnt	Op.	6.0	6.0	6.0	6.0	6.0
	Cap.	..	..	..	..	..
Chemically Bonded	Op.	18.0	18.0	18.0	18.0	18.0
	Cap.	..	..	..	..	..
TOTAL		**24.0**	**24.0**	**24.0**	**24.0**	**24.0**
Dead Burnt Magnesite	Op.	8.8	8.8	8.8	8.8	8.8
Basic Ramming Mass.	Op.	..	..	..	..	..
TOTAL		**8.8**	**8.8**	**8.8**	**8.8**	**8.8**

DURGAPUR STEEL PLANT, DURGAPUR

(Operational & Capital repairs requirements from 1971 *to* 1980)

(In '000 tonnes)

		1971	1972	1973	1974	1975
Silica :						
Coke Ovens :						
(a) Repairs	Op.	0.5	0.5	0.5	0.5	0.5
(b) Rebuilt	Op.	..	..	..	6.0	..
Silica others	Op.	1.2	1.3	1.4	1.4	1.4
TOTAL .		**1.7**	**1.8**	**1.9**	**7.9**	**1.9**

		1976	1977	1978	1979	1980
Silica :						
Coke Ovens :						
(a) Repairs	Op.	0.5	0.5	..	..	..
(b) Rebuilt	Op.	..	6.0	..	6.0	..
Silica others	Op.	1.4	1.4	1.4	1.4	1.4
TOTAL .		**1.9**	**7.9**	**1.4**	**7.4**	**1.4**

ROURKELA STEEL PLANT, ROURKELA

(*Operational & Capital repairs requirements from* 1971 *to* 1980)

(In '000 tonnes)

		1971				1972			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonnes)		..	..	1.6	..	..	..	1.6	..
Fireclay and high alumina bricks :									
Ladles Steel	Op.	..	..	17.2	1.0	..	..	19.5	..
	Cap.	..	..	..	..	..	..	..	..
BF & Others	Op.	..	..	1.5	..	..	..	2.0	..
OH Checkers	Op.	..	..	1.0	..	..	..	1.0	..
	Cap.	..	..	..	..	..	..	..	..
BF Checkers	Op.	...	..	..	..	..	..	..	..
	Cap.	..	..	..	..	0.4	..	1.0	1.0
CO Checkers	Op.	..	..	..	0.2	..	..	..	0.2
	Cap.	..	..	..	..	..	..	..	0.6
Soaking Pit	Op.	..	..	0.2	..	..	..	0.2	..
Covers	Cap.	..	..	..	..	..	..	..	..
Blast Furnace	Op.	..	0.3	..	..	..	0.3	..	..
Proper	Cap.	..	..	..	..	0.5	1.7	..	..
Stoves & Others	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	0.7	..	1.4	..
Coke Oven Shapes	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	1.6	1.5
Others	Op.	0.4	..	0.8	..	0.4	..	0.8	..
	Cap.	..	..	1.0	..	0.3	..	1.0	..
Pouring	Op.	..	..	1.8	1.8	..	..	2.0	2.0
TOTAL		**0.4**	**0.3**	**23.5**	**2.0**	**2.3**	**2.0**	**30.5**	**5.3**

ROURKELA STEEL PLANT, ROURKELA

(Operational & Capital repairs requirements from 1971 to 1980)

(In '000 tonnes)

		1973				1974			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonnes)		..	..	1.6	..	..	..	1.6	..
Fireclay and high alumina bricks :									
Ladles: Steel	Op.	..	..	19.5	..	..	..	19.5	..
	Cap.	..	..	..	..	..	..	..	..
BF & Others	Op.	..	..	2.0	..	..	..	2.0	..
OH Checkers	Op.	..	..	1.0	..	..	..	1.0	..
	Cap.	..	..	..	..	..	..	..	..
BF Checkers	Op.	..	..	..	..	..	..	..	..
	Cap.	0.4	..	1.0	1.0	0.4	..	1.0	1.0
CO Checkers	Op.	..	..	..	..	..	..	..	0.2
	Cap.	..	..	..	0.6	..	..	..	..
Soaking Pit	Op.	..	..	0.4	..	..	..	0.2	..
Covers	Cap.	..	..	..	..	..	..	..	..
Blast Furnace	Op.	..	0.3	..	..	..	0.3	..	..
Proper	Cap.	0.3	1.3	..	..	0.3	1.3	..	..
Stoves & Others	Op.	..	..	..	..	..	..	..	..
	Cap.	0.7	..	1.4	..	0.7	..	1.4	..
Coke Oven Shapes	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	1.6	1.5	..	..	..	..
Others	Op.	0.4	..	0.8	..	0.4	..	0.8	..
	Cap.	0.1	..	1.0	..	0.1	..	1.0	..
Pouring	Op.	..	..	2.0	2.0	..	..	2.0	2.0
TOTAL		**1.9**	**1.6**	**30.7**	**5.1**	**1.9**	**1.6**	**28.9**	**3.2**

ROURKELA STEEL PLANT, ROURKELA

(Operational & Capital repairs requirements from 1971 to 1980)

(In '000 tonnes)

		1975				1976			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonnes)		..	1.6	..	..	..	1.8	..	..
Fireclay and high alumina bricks :									
Ladles: Steel	Op.	..	..	19.5	..	..	..	19·5	..
	Cap.	..	..	..	..	..	..	..	..
BF & Others	Op.	..	..	2.0	..	..	..	2.0	..
OH Checkers	Op.	..	..	1.0	..	..	..	1.0	..
	Cap.	..	..	..	..	..	..	..	..
BF Checkers	Op.	..	..	..	..	..	..	..	..
	Cap.	0.4	..	1.0	1.0	..	..	..	..
CO Checkers	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	1.2	..	..	..	..
Soaking Pit	Op.	..	..	0.2	..	..	..	0.4	..
Covers	Cap.	..	..	..	..	..	..	..	..
Blast Furnace	Op.	..	0.3	..	..	..	0.3	..	..
Proper	Cap.	0.3	1.3	..	..	..	..	..	..
Stoves & Others . . .	Op.	..	..	..	..	..	..	..	..
	Cap.	0.7	..	1.4	..	..	..	..	..
Coke Oven Shapes . . .	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	3.2	3.0	..	..	..	..
Others	Op.	0.4	..	0.8	..	0.4	..	0.8	..
	Cap.	0.1	..	1.0	..	0.3	..	1.0	..
Pouring	Op.	..	..	2.0	2.0	..	..	2.0	2.0
TOTAL		1.9	1.6	32.1	7.2	0.7	0.3	26.7	2.0

ROURKELA STEEL PLANT, ROURKELA

(*Operational & Capital repairs requirements from* 1971 *to* 1980)

(In '000 tonnes)

		1977				1978			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonnes)		..	..	1.8	..	..	1.8	..	..
Fireclay and high alumina bricks :									
Ladles : Steel	Op.	..	..	19.5	..	..	..	19.5	..
	Cap.	..	..	..	..	..	..	..	..
BF & Others	Op.	..	..	2.0	..	..	..	2.0	..
OH Checkers	Op.	..	..	1.0	..	..	..	1.0	..
	Cap.	..	..	..	..	..	..	..	..
BF Checkers	Op.	..	..	..	..	..	..	..	..
	Cap.	0.4	..	..	..	0.4	..	..	..
CO Checkers	Op.	..	..	..	2.0	..	..	..	..
	Cap.	..	..	..	..	..	..	..	1.2
Soaking Pit	Op.	..	..	0.2	..	..	..	0.2	..
Covers	Cap.	..	..	..	..	..	..	..	..
Blast Furnace	Op.	..	0.3	..	..	..	0.3	..	..
Proper	Cap.	0.5	2.2	..	..	0.3	1.6	..	..
Stoves & Others	Op.	..	..	..	..	..	..	..	..
	Cap.	0.3	..	..	..	0.3	..	..	..
Coke Oven Shapes	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	..	..	..	3·2	3.0
Others	Op.	0.4	..	0.8	..	0.4	..	0.8	..
	Cap.	0.1	..	1.0	..	0.1	..	1.0	..
Pouring	Op.	..	..	2.0	2.0	..	..	2.0	2.0
TOTAL		**1.7**	**2.5**	**26.5**	**2.2**	**1.5**	**1.9**	**29.7**	**6.2**

ROURKELA STEEL PLANT, ROURKELA

(Operational & Capital repairs requirements from 1971 *to* 1980)

(In '000 tonnes)

		1979				1980			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonnes)		..	..	1.8	..	..	1.8	..	..
Fireclay and high alumina bricks :									
Ladles : Steel	Op.	..	..	19.5	..	..	..	19.5	..
	Cap.	..	..	..	..	..	..	..	..
BF & Others	Op.	..	..	2.0	..	..	..	2.0	..
OH Checkers	Op.	..	..	1.0	..	..	..	1.0	..
	Cap.	..	..	..	..	..	..	..	..
BF Checkers	Op.	..	..	..	..	..	..	..	..
	Cap.	0.4	..	..	..	0.4	..	..	..
CO Checkers	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	..	1.6	..	..	..	..
Soaking Pit	Op.	..	..	0.4	..	..	..	0.2	..
Covers	Cap.	..	..	..	..	..	..	..	..
Blast Furnance	Op.	..	0.3	..	..	..	0.3	..	..
Proper	Cap.	0.3	1.6	..	..	0.3	1.6	..	..
Stoves & Others	Op.	..	..	..	..	..	..	..	..
	Cap.	0.3	..	..	..	0.3	..	..	..
Coke Oven Shapes	Op.	..	..	..	..	..	..	..	..
	Cap.	..	..	3.9	3.8	..	..	..	..
Others	Op.	0.4	..	0.8	..	0.4	..	0.8	..
	Cap.	0.1	..	1.0	..	0.1	..	1.0	..
Pouring	Op.	..	..	2.0	2.0	..	..	2.0	2.0
TOTAL		1.5	1.9	30.6	7.4	1.5	1.9	26.5	2.0

ROURKELA STEEL PLANT, ROURKELA

(*Operational & Capital repairs requirements from* 1971 *to* 1980)

(In '000 tonnes)

	1971	1972	1973	1974	1975
STEEL INGOT PRODUCTION (In Million Tonnes)	1.6	1.6	1.6	1.6	1.6
BASIC :					
Burnt : (a) Operational	2.7	2.7	2.7	2.7	2.7
(b) Capital	0.4	1.5	1.5	1.2	1.0
(c) Constructional	..	..	..	..	..
Chemically Bonded :					
(a) Operational	2.0	2.0	2.0	2.0	2.0
(b) Capital	..	..	..	..	..
(c) Constructional	..	..	..	..	..
TOTAL	5.1	6.2	6.2	5.9	5.7
Dead burnt magnesite:					
Operational	1.5	1.5	1.5	1.5	1.5
Basic Ramming Mass:					
Operational	0.2	0.2	0.2	0.2	0.2
TOTAL	1.7	1.7	1.7	1.7	1.7
Tar Bonded Dolomite :					
Operational	14.0	17.0	17.0	17.0	17.0

	1976	1977	1978	1979	1980
STEEL INGOT PRODUCTION (In Million Tonnes)	1.8	1.8	1.8	1.8	1.8
BASIC :					
Burnt : (a) Operational	2.7	2.7	2.7	2.7	2.7
(b) Capital	0.8	1.0	1.0	1.0	1.0
(c) Constructional	..	..	..	..	..
Chemically Bonded :					
(a) Operational	2.0	2.0	2.0	2.0	..
(b) Capital	..	..	..	..	..
(c) Constructional	..	..	..	..	..
TOTAL	5.5	5.7	5.7	5.7	5.7
Dead burnt magnesite:					
Operational	1.5	1.5	1.5	1.5	1.5
Basic Ramming Mass :					
Operational:	0.2	0.2	0.2	0.2	0.2
TOTAL	1.7	1.7	1.7	1.7	1.7
Tar Bonded Dolomite :					
Operational	17.0	17.0	17.0	17.0	17.0

ROURKELA STEEL PLANT, ROURKELA

(Operational and Capital Repairs Requirements from 1971 to 1980)

(In '000 tonnes)

		1971	1972	1973	1974	1975
SILICA						
Coke Oven :	(a) Repairs:	..	3.0	2.0	1.0	..
	(b) Re-build	..	3.2	3.2	..	6.4
Roof	Operational	0.01	0.01	0.01	0.01	0.01
Convertors		..	..	..	..	..
Others		0.6	0.6	0.6	0.6	0.6
	TOTAL	**0.61**	**6.81**	**5.81**	**1.61**	**7.01**

		1976	1977	1978	1979	1980
SILICA :						
Coke Oven :	(a) Repairs	0.5	1.0	..	..	..
	(b) Re-build	..	..	6.4	7.3	..
Roof :	Operational	0.01	0.01	0.01	0.01	0.01
Convertors :						
Others		0.6	0.6	0.6	0.6	0.6
	TOTAL	**1.11**	**1.61**	**7.01**	**7.91**	**0.61**

INDIAN IRON & STEEL CO. LIMITED, BURNPUR

(Operational, Capital and Constructional Requirements from 1971 *to* 1980)

(In '000 tonne)

		1971				1972			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonnes)									
By LD		..	..	..	..	..	..	..	..
By OH		..	1.0	..	..	..	1.0	..	..
By Electric		..	..	..	..	..	..	..	..
Fireclay and high allumina bricks									
Ladles : Steel	Op.	..	..	..	22.0	..	..	..	22.0
BF & Others	Op.	..	..	..	3.4	..	..	..	3.4
OH Checkers	Op.	..	..	2.9	..	..	..	2.9	..
	Cap.	..	..	..	..	..	..	..	..
BF Checkers	Op.	..	..	..	1.0	..	..	..	1.0
	Cap.	..	..	..	..	..	..	..	..
CO Checkers	OP.	..	..	..	0.5	..	..	..	0.5
	Cap.	..	..	..	..	..	..	..	2.3
	Constn.	..	..	..	..	..	..	..	..
Soaking Pit	Op.	..	..	0.2	0.1	..	..	0.1	0.2
Cover :									
Blast Furnace	Op.	..	..	..	2.9	..	..	..	2.9
Proper	Cap.	..	..	..	..	..	..	..	..
Stoves & Others	Op.	..	..	..	1.8	..	..	..	1.8
	Cap.	..	..	..		..	..	..	..
CO Shapes	Op.	..	..	..	0.2	..	..	..	0.2
	Cap.	..	..	..	..		..	..	1.4
	Constn	..	..	..	..	..	..	..	..
Others :	Op.	0.2	..	..	12.0	0.2	..	..	17.0
Pouring :	Op.	..	..	..	2.3	..	..	..	2.3
TOTAL		**0.2**	..	**3.1**	**51.2**	**0.2**	..	**3.0**	**55.0**

INDIAN IRON & STEEL COMPANY LIMITED, BURNPUR

(*Operational, Capital & Constructional Requirements from* 1971 *to* 1980)

(In '000 tonnes)

		1973				1974			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonne)									
By LD		..	..	..	..	..	0.3	..	..
By OH		..	..	1.0	..	..	1.0	..	..
By Electric		..	..	..	..	..	..	..	..
Fireclay and high alumina bricks									
Ladles : Steel	Op	..	..	..	22.0	..	..	..	26.0
BF & Others	Op.	..	..	..	3.4	..	..	..	4.5
OH Checkers	Op.	..	..	2.9	..	..	..	2.9	..
	Cap.	..	..	..	..	..	..	..	..
BF Checkers	Op.	..	..	..	1.0	..	..	..	1.3
	Cap.	..	..	..	..	..	..	..	..
CO Checkers	Op.	..	..	..	0.5	..	..	..	0.5
	Cap.	..	..	..	..	..	..	..	..
	Constn.	..	..	..	..	..	..	..	1.3
Soaking Pit	Op.	..	..	0.2	0.1	..	..	0.1	0.2
Covers									
Blast Furnace	Op.	..	..	..	2.0	..	..	..	2.0
Proper	Cap.	..	..	..	..	..	..	..	..
Stoves & Others	Op.	..	..	..	1.5	..	..	..	1.5
	Cap.	..			..	..		..	..
CO Shapes	Op.	..	..	..	0.2	..	..	..	0.2
	Cap.	..	..	..	..	..	..	..	..
	Constn.	..	..	..	..	..	..	..	..
Others:	Op.	0.2	..	..	17.0	0.2	..	..	20.4
Pouring	Op.	..	..	..	2.3	..	..	..	2.7
	TOTAL	0.2	..	3.1	50.0	0.2	..	3.0	67.6

INDIAN IRON & STEEL COMPANY LTD., BURNPUR

(Operational, Capital & Constructional Requirements from 1971 *to* 1980)

(In '000 tonnes)

		1975				1976			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonnes)									
By LD		..	0.5	..	..	..	1.0	..	..
By OH		..	0.8	..	..	..	0.2	..	..
By Electric		..	..	..	..	..	0.1	..	..
Fireclay and high alumina bricks									
Ladles : Steel	Op.	..	..	..	26.0	..	..	..	26.0
BF & Others	Op.	..	..	..	4.5	..	..	..	4.5
OH Checkers :	Op.	..	..	2.3	..	..	..	0.9	..
	Cap.	..	..	..	..	..	..	..	..
BF Checkers :	Op.	..	..	..	1.3	..	..	..	1.3
	Cap.	..	..	..	..	..	..	..	..
CO Checkers :	Op.	..	..	..	0.5	..	..	..	0.5
	Cap.	..	..	..	..	..	..	..	..
	Constn	..	..	..	..	..	..	..	1.3
Soaking Pit Covers :	Op.	..	..	0.2	0.1	..	..	0.1	0.2
Blast Furnace Proper :	Op.	..	..	..	2.9	..	..	..	2.9
	Cap.	..	..	..	..	..	..	..	..
Stoves & Others	Op.	..	..	..	1.8	..	..	..	1.8
	Cap.	..	..	..	..	..	..	..	..
CO Shapes :	Op.	..	..	..	0.2	..	..	..	0.2
	Cap.	..	..	..	..	..	..	..	..
	Constn.	..	..	..	..	..	..	..	7.0
Others :	Op.	0.2	..	..	20.4	0.2	..	..	20.4
Pouring	Op.	..	..	..	2.7	..	..	..	2.7
	TOTAL	**0.2**	..	**2.5**	**60.4**	**0.2**	..	**1.0**	**68.8**

INDIAN IRON & STEEL COMPANY LTD., BURNPUR

(Operational, Capital & Constructional Requirements from 1971 *to* 1980)

(In '000 tonnes)

		1977				1978			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonnes)									
By LD		..	..	1.2	..	..	..	1.2	..
By OH		..	..	..	..	..	..	..	..
By Electric		..	..	0.1	..	..	..	0.1	..
Fireclay and high alumina bricks									
Ladles : Steel	Op.	..	..	..	26.0	..	..	..	26.C
BF & Others	Op.	..	..	..	4.5	..	..	..	4.5
OH Checkers	Op.	..	..	..	..	..	..	..	..
BF Checkers	Op.	..	..	..	1.3	..	..	..	1.3
CO Checkers	Op.	..	..	..	0.5	..	..	..	0.5
	Cap.	..	..	..	..	..	..	..	..
	Constn.	..	..	..	..	..	..	..	..
Soaking Pit	Op.	..	..	0.2	0.1	..	..	0.1	0.2
Covers :									
Blast Furnace	Op.	..	..	..	2.0	..	..	..	2.0
Proper :									
Stoves & Others	Op.	..	..	..	1.5	..	..	..	1.5
CO Shapes	Op.	..	..	..	0.2	..	..	..	0.2
	Constn.	..	..	..	..	..	..	..	..
Others :	Op.	0.2	..	..	20.4	0.2	..	..	20.4
Pouring :	Op.	..	..	..	2.7	..	..	..	2.7
	TOTAL	**0.2**	..	**0.2**	**59.2**	**0.2**	..	**0.1**	**59 3**

INDIAN IRON & STEEL COMPANY LIMITED, BURNPUR

(Operational, Capital & Constructional Requirements from 1971 *to* 1980)

(in '000 tonnes)

		1979				1980			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonnes)									
By LD		..	1.2	..	..	..	1.2	..	..
By OH		..	..	..	..	..	..	..	..
By Electric		..	0.1	..	..	..	0.1	..	..
Fireclay and high alumina brickas									
Ladles : Steel	Op.	..	..	..	26.0	..	..	..	26.0
BF & Others	Op.	..	..	..	4.5	..	..	..	4.5
OH Checkers	Op.	..	..	..	..	..	..	..	..
BF Checkers	Op.	..	..	..	1.3	..	..	..	1.3
CO Checkers	Op.	..	..	..	0.5	..	..	..	0.5
	Cap.	..	..	..	..	..	..	..	..
	Constn.	..	..	..	..	..	..	..	..
Soaking Pit	Op.	..	..	..	0.3	..	..	..	0.3
Covers :									
Blast Furnace	Op.	..	..	..	2.9	..	..	..	2.9
Proper :									
Stoves & Others :	Op.	..	..	..	1.8	..	..	..	1.8
CO Shapes	Op.	..	..	..	0.2	..	..	..	0.2
	Constn.	..	..	..	..	..	..	..	..
Others :	Op.	0.2	..	..	20.4	0.2	..	..	20.4
Pouring :	Op.	..	..	..	2.7	..	..	..	2.7
TOTAL		**0.2**	..	..	**60.6**	**0.2**	..	..	**60.6**

INDIAN IRON & STEEL COMPANY LIMITED, BURNPUR

(Operational, Capital & Constructional Requirements from 1971 *to* 1980)

(In '000 tonnes)

		1971	1972	1973	1974	1975
STEEL INGOT PRODUCTION (In Million Tonnes)						
By LD		..	..	..	0.3	0.5
By OH		1.0	1.0	1.0	1.0	0.8
By Electric		..	..	..	..	..
BASIC						
Basic Burnt	Op.	6.9	6.9	6.9	7.7	6.9
	Cap.	..	..	..	..	..
	Constn.	..	..	..	0.5	..
Basic	Op.	2.5	2.5	2.5	2.5	2.0
Chemically	Cap.	..	..	..	..	..
Bonded	Constn.	..	..	..	..	..
TOTAL		**9.4**	**9.4**	**9.4**	**10.7**	**8.9**
Dead Burnt Magnesite:		2.8	2.8	2.8	2.8	2.2
Basic Ramming Mass :						
TOTAL		**2.8**	**2.8**	**2.8**	**2.8**	**2.2**
Tar Bonded Dolomite :						
	Op.	..	..	..	4.2	7.0
	Constn.	..	..	..	1.0	..
	TOTAL	..	..	..	**5.2**	**7.0**

		1976	1977	1978	1979	1980
STEEL INGOT PRODUCTION (In Million Tonnes)						
By LD		1.0	1.2	1.2	1.2	1.2
By OH		0.2	..	..	..	..
By Electric		0.1	0.1	0.1	0.1	0.1
BASIC						
Basic Burnt	Op.	4.6	3.8	3.8	3.8	7.8
	Cap.	..	..	..	..	..
	Constn.	..	..	..	..	..
Basic	Op.	1.0	0.5	0.5	0.5	0.5
Chemically	Cap.	..	..	..	..	..
Bonded	Constn.	..	..	..	..	..
TOTAL		**5.6**	**4.3**	**4.3**	**4.3**	**4.3**
Dead Burnt Magnesite		0.8	..	..	..	..
Basic Ramming Mass						
TOTAL		**0.8**	..	..	..	..
Tar Bonded Dolomite		14.0	18.2	18.2	18.2	18.2
	Op.	..	..	..	..	..
	Constn.	..	..	..	..	..
	TOTAL	**14.0**	**18.2**	**18.2**	**18.2**	**18.2**

INDIAN IRON & STEEL COMPANY LIMITED, BURNPUR

(Operational, Capital & Construction Requirements from 1971 *to* 1980)

(In '000 tonnes)

	1971	1972	1973	1974	1975
SILICA :					
Coke Oven :					
(a) Operation	0.1	0.1	0.1	0.1	0.1
(b) Rebuild	..	1.1	..	..	..
(c) Constn.	..	..	..	7.0	..
Roof :	2.3	2.3	2.3	2.3	1.8
Converters :	5.8	5.8	5.8	5.8	4.7
Others :	6.8	6.8	6.8	6.8	5.5
TOTAL	**15.0**	**16.1**	**15.0**	**22.0**	**12.1**

	1976	1977	1978	1979	1980
SILICA					
Coke Oven :					
(a) Operation	0.1	0.1	0.1	0.1	0.1
(b) Rebuild	..	..	..	..	..
(c) Constn.	7.0	..	..	..	..
Roof	0.7	0.7	0.7	0.7	0.7
Converters	1.2	..	..	..	..
Others :	2.1	1.0	1.0	1.0	1.0
TOTAL	**11.1**	**1.8**	**1.8**	**1.8**	**1.8**

TATA IRON & STEEL COMPANY LIMITED, JAMSHEDPUR

(Operational and Capital Repairs & new Constructional Requirements from 1971 *to* 1980)

(In '000 tonnes)

		1971				1972			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonnes)		..	..	1.8	..	..	2.0	..	..
Fireclay and high alumina bricks									
Ladles : Steel	Op. Cap.	..	10.0	21.5	..	..	13.5	17.0	..
BF & Others	,,	..	..	..	..	..	..		..
OH Checkers	,,	..	..	8.3	..	..	..	5.0	3.5
BF Checkers	,,	0.5	..	2.1	..	0.5	..	2.1	..
CO Checkers	,,	..	..	..	2.6	..	..	..	1.0
	Const.	..	..	..	1.0	..	..	..	1.0
Soaking Pit									
Covers	Op.		..	..	..	..	..	..	..
	Cap.	0.3	..	..	0.1	0.3	..	..	0.1
Blast Furnace									
Proper	,,	..	2.7	..	..	..	2.8	..	..
Stoves & others	,,	1.1	..	2.0	..	1.1	..	2.0	..
Coke Oven Shapes	,,	..	..	..	3.3	..	..	..	2.0
	Const.	..	..	0.5	3.5	..	..	0.5	3.5
Others	Op/Cap.	0.3	..	8.0	13.8	2.6	..	8.0	13.8
Pouring	,,	..	..	..	2.7	..	..	..	2.7
TOTAL		**2.2**	**12.7**	**42.4**	**27.0**	**4.5**	**16.3**	**34.6**	**27.6**

	1973				1974			
	HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonnes) ..	..	..	2.0	..	..	2.0	..	..

Fireclay and high alumina bricks

TATA IRON & STEEL COMPANY LIMITED, JAMSHEDPUR

(Operational & Capital Repairs & new Constructional Requirements from 1971 *to* 1980)

		1975				1976			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonnes)		..	2.0	..	..	..	2.0	..	..
Fireclay and high alumina bricks									
Ladles : Steel	Op/Cap.	..	13.5	17.0	..	..	13.5	17.0	..
BF & Others	,,	..	..	..	..	..	..	..	..
OH Checkers	,,	..	..	5.0	3.5	..	..	5.0	3.5
BF Checkers	,,	..	0.5	..	2.1	0.5	..	2.1	..
CO Checkers	,,	..	..	..	1.0	..	..	..	0.5
	Const.	..	..	..	0.9	..	..	..	..
Soaking Pit	,,	..	..	..	..	0.3	..	..	0.1
Covers		0.3	..	..	0.1	..	..	..	..
Blast Furnace									
Proper	,,	..	2.8	..	..	..	2.8	..	..
Stoves & others	,,	1.1	..	2.0	..	1.1	..	2.0	..
Coke Oven		..	..	2.0	2.0	..	..	..	..
Shapes	,,	..	..	0.2	3.0	..	..	..	1.0
Others	,,	2.5	..	8.0	13.8	0.3	..	8.0	13.8
Pouring	,,	..	..	..	2.7	..	..	..	2.7
TOTAL		**4.4**	**16.3**	**34.3**	**27.0**	**2.2**	**16.3**	**34.1**	**21.6**

		1977				1978			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonnes)		..	2.0	..	..	..	2.0	..	..
Fireclay and high alumina bricks									
Ladles : Steel	Op/Cap.	..	13.5	17.0	..	..	13.5	17.0	..
BF & Others	,,	..	..	..	..	..	..	..	..
OH Checkers	,,	..	..	5.0	3.5	..	..	5.0	3.5
BF Checkers	,,	0.5	..	2.1	..	0.5	..	2.1	..
CO Checkers	,,	..	..	..	0.5	..	..	..	0.5
Soaking Pit									
Covers	,,	0.3	..	..		0.1	0.3	..	0.1
Blast Furnace									
Proper	,,	..	2.8	..	..	..	2.8	..	..
Stoves & others	,,	1.1	..	2.0	..	1·1	..	2·0	..
Coke Oven									
Shapes	,,	..	..	..	1.0	..	..	..	1.0
Others	,,	0.3	..	8.0	13.8	0.3	..	8.0	13.8
Pouring	,,	..	..	..	2.7	..	..	..	2.7
TOTAL		**2.2**	**16.3**	**34.1**	**21.6**	**2.2**	**16.3**	**34.1**	**21.6**

TATA IRON & STEEL COMPANY LIMITED, JAMSHEDPUR

(*Operational & Capital Repairs & new Constructional Requirements from* 1971 *to* 1980)

(In '000 tonnes)

		1979				1980			
		HA	HG	LG	PL	HA	HG	LG	PL
STEEL INGOT PRODUCTION (In Million Tonnes)	.	..	2.0	..	..	..	..	2.0	..
Fireclay and high alumina bricks									
Ladles : Steel BF & Others	Op./Cap.	..	13.5	17.0	..	..	13.5	17.0	..
OH Checkers	,, .	..	..	5.0	3.5	..	..	5.0	3.5
BF Checkers	,, .	0.5	..	2.1	..	0.5	..	2.1	..
CO Checkers	,, .	..	..	..	0.5	..	..	..	0.5
Soaking Pit									
Covers	,,	..	2.8	..	0.1	..	2.8	..	0.1
Blast Furnace									
Proper	,, .	..	2.8	..	..	..	2.8	..	..
Stove & Others	,, .	1.1	..	2.0	..	1.1	..	2.0	..
Coke Oven									
Shapes	,, .	..	..	..	1.0	..	..	..	1.0
Others	,, .	0.3	..	8.0	13.8	0.3	..	8.0	13.8
Pouring	,, .	..	..	..	2.7	..	..	..	2.7
TOTAL	. . . .	2.2	**16.3**	**34.1**	**21.6**	**2.2**	**16.3**	**34.1**	**21.6**

TATA IRON & STEEL COMPANY LIMITED, JAMSHEDPUR

(Operational & Capital Repairs & new Constructional Requirements from 1971 *to* 1980)

(In '000 tonnes)

	1971	1972	1973	1974	1975
STEEL INGOT PRODUCTION (In Million Tonnes)	1.8	1.8	2.0	2.0	2.0
BASIC					
Burnt : Operational & Capital Constructional	9.6	9.5	9.5	9.5	9.5
Chemically Bonded : Operational & Capital	5.4	5.5	5.5	5.5	5.5
TOTAL	15.0	15.0	15.0	15.0	15.0
Burnt Dolomite : Operational	42.0	43.0	43.0	43.0	43.0
Dead Burnt Magnesite : Operational	4.0	4.0	4.0	4.0	4.0
Basic Ramming Mass : Operational	1.8	2.0	2.0	2.0	2.0
TOTAL	**47.8**	**49.0**	**49.0**	**49.0**	**49.0**

	1976	1977	1978	1979	1980
STEEL INGOT PRODUCTION (In Million Tonnes)	2.0	2.0	2.0	2.0	2.0
BASIC					
Burnt : Operational & Capital Constructional	8.5	8.5	8.5	9.5	9.5
Chemically Bonded : Operational & Capital	5.5	5.5	5.5	5.5	5.5
TOTAL	15.0	15.0	15.0	15.0	15.0
Burnt Dolomite : Operational	..	..	..	..	..
Dead Burnt Magnesite : Operational	4.0	4.0	4.0	4.0	4.0
Basic Ramming Mass : Operational	2.0	2.0	2.0	2.0	2.0
TOTAL	**6.0**	**6.0**	**6.0**	**6.0**	**6.0**

TATA IRON & STEEL COMPANY, LIMITED, JAMSHEDPUR

(Operational & Capital Repairs and new Constructional Requirements from 1971 *to* 1980)

(In '000 tonnes)

		1971	1972	1973	1974	1975
SILICA :						
Coke Oven :	Operational & Capital	4.5	3.0	3.0	3.0	3.0
	Constructional	4.0	4.0	4.0	2.0	3.3
Roof :	Operational & Capital	6.5	4.8	4.8	4.8	4.8
Converters :	Operational & Capital	5.4	5.4	5.4	5.4	5.4
Others :	Operational & Capital	6.0	6.5	6.5	6.5	6.5
	TOTAL	**26.4**	**23.7**	**23.7**	**21.7**	**23.0**

		1976	1977	1978	1979	1980
SILICA						
Coke Oven :	Operational & Capital	0.1	0.1	0.1	0.1	0.1
	Constructional	1.2	..	..	..	..
Roof :	Operational & Capital	4.8	4.8	4.8	4.8	4.8
Converters :	Operational & Capital	5.4	5.4	5.4	5.4	5.4
Others :	Operational & Capital	6.5	6.5	6.5	6.5	6.5
	TOTAL	**18.0**	**16.8**	**16.8**	**16.8**	**16.8**

MYSORE IRON & STEEL CO. LTD., BHADRAVATI

(*Operational & Capital Repairs Requirements from* 1971 *to* 1980)

(In '000 tonnes)

	1971	1972	1973	1974	1975
STEEL INGOT PRODUCTION (In Million Tonne)	0.18	0.18	0.18	0.18	0.18
FIREBRICKS					
Except High Alumina containing Al_2O_3 35% and above, rest demand being met from their own captive Refractories Plant.					
High Alumina (above 35% alumina)	2.3	2.3	2.3	2.3	2.3
TOTAL	**2.3**	**2.3**	**2.3**	**2.3**	**2.3**
BASIC					
Burnt Chemically Bonded	5.9	5.9	5.9	5.9	5.9
TOTAL	**5.9**	**5.9**	**5.9**	**5.9**	**5.9**
Dead Burnt Magnesite	2.0	2.0	2.0	2.0	2.0
SILICA					
Roof	1.5	1.5	1.5	1.5	1.5
Convertors	..	..	..	..	..
Others	0.3	0.3	0.3	0.3	0.3
TOTAL	**1.8**	**1.8**	**1.8**	**1.8**	**1.8**

	1976	1977	1978	1979	1980
STEEL INGOT PRODUCTION (In Million Tonne)	0.18	0.18	0.18	0.18	0.18
FIREBRICKS					
Except High Alumina containing Al_2O_3 35% and above, rest demand being met from their own captive Refractories Plant.					
High Alumina (Above 35% alumina)	2.3	2.3	2.3	2.3	2.3
TOTAL	**2.3**	**2.3**	**2.3**	**2.3**	**2.3**
BASIC					
Burnt	5.9	5.9	5.9	5.9	5.9
Chemically Bonded					
TOTAL	**5.9**	**5.9**	**5.9**	**5.9**	**5.9**
Dead Burnt Magnesite	2.0	2.0	2.0	2.0	2.0
SILICA					
Roof	1.5	1.5	1.5	1.5	1.5
Convertors	..	..	..	..	..
Others	0.3	0.3	0.3	0.3	0.3
TOTAL	**1.8**	**1.8**	**1.8**	**1.8**	**1.8**

BHILAI EXPANSION, BOKARO & NEW STEEL PLANTS

(*Constructional & Operational Requirements from* 1971 *to* 1980)

(In '000 tonnes)

	1971				1972			
	HA	HG	LG	PL	HA	HG	LG	PL
FIREBRICKS	..	..	..	..	..	..	..	..
BHILAI—Expansion	..	..	..	..	..	..	..	..
BOKARO								
Steel Ingot Prodn. (In Million tonne)	..	..	..	..	..	0.202	..	..
(a) Constructional	..	..	0.7	..	4.3	1.4	10.4	..
(b) Operational	..	..	..	..	0.2	3.0	1.6	0.2
SALEM								
VIZAG								
HOSPET								
Steel Ingot Prodn. (In million tonne)	..	..	..	..	..	..	..	..
(a) Constructional	..	..	..	..	..	..	..	..
(b) Operational	..	..	..	..	..	..	..	..
NSP I								
Steel Ingot Prodn. (In million tonne)	..	..	..	..	..	..	..	
(a) Constructional	..	..	..	..	..	..	..	..
(b) Operational	..	..	..	..	..	..	..	..
NSP II								
Steel Ingot Prodn. (In million tonne)	..	..	..	..	..	..	..	..
(a) Constructional	..	..	..	..	..	..	..	..
(b) Operational	..	..	..	..	..	..	..	..
NSP III								
Steel Ingot Prodn. (In Million tonne)	..	..	..	..	..	..	..	..
(a) Constructional	..	..	..	..	..	..	..	..
(b) Operational	..	..	..	..	..	..	..	..
NSP IV								
Steel Ingot Prodn. (In Million Tonne)	..	..	..	..	..	..	..	..
(a) Constructional	..	..	..	..	..	..	..	..
(b) Operational	..	..	..	..	..	..	..	..
NSP V								
Steel Ingot Prodn. (In Million tonnes)	..	..	..	..	..	..	..	..
(a) Constructional	..	..	..	..	..	..	..	..
(b) Operational	..	..	..	..	..	..	..	..
TOTAL	..	..	0.7	..	4.5	4.4	12.0	0.2

BHILAI EXPANSION, BOKARO & NEW STEEL PLANTS

(Constructional & Operational Requirements from 1971 *to* 1980)

(In '000 tonnes)

	1973				1974			
	HA	HG	LG	PL	HA	HG	LG	PL
FIREBRICKS	..	..	..	..	..	..	..	..
BHILAI—Expansion								
(a) Constructional	..	2.8	2.8	2.8	..	1.9	1.9	1.9
(b) Operational	..	..	..	..	..	..	..	..
BOKARO								
Steel Ingot Prodn. (In million tonnes)	..	..	0.60	..	..	..	0.80	..
(a) Constructional	9.0	..	10.7	..	9.0	1.8	11.5	..
(b) Operational	0.5	8.8	4.9	0.6	0.6	11.8	6.5	0.8
SALEM	..	..	..	..	..	..	..	..
VIZAG								
(a) Constructional	..	..	..	..	6.5	3.5	18.0	..
(b) Operational	..	..	..	..	..	..	..	..
HOSPET								
Steel Ingot Prodn. (In million tonnes)	..	..	..	..	..	..	..	..
(a) Constructional	..	..	..	..	6.5	3.5	18.0	..
(b) Operational	..	..	..	..	..	..	..	..
NSP I								
Steel Ingot Prodn. (In million tonnes)	..	..	..	..	..	..	..	..
(a) Constructional	..	..	..	..	..	..	..	..
(b) Operational	..	..	..	..	..	..	..	..
NSP II								
Steel Ingot Prodn. (In million tonnes)	..	..	..	..	..	..	..	..
(a) Constructional	..	..	..	..	..	..	..	..
(b) Operational	..	..	..	..	..	..	..	..
NSP III								
Steel Ingot Prodn. (In million tonnes)	..	..	..	..	..	..	..	..
(a) Constructional	..	..	..	..	..	..	..	..
(b) Operational	..	..	..	..	..	..	..	..
NSP IV								
Steel Ingot Prodn. (In million tonnes)	..	..	..	..	..	..	..	..
(a) Constructional	..	..	..	..	..	..	..	..
(b) Operational	..	..	..	..	..	..	..	..
NSP V								
Steel Ingot Prodn. (In million tonnes)	..	..	..	..	..	..	..	..
(a) Constructional	..	..	..	..	..	..	..	..
(b) Operational	..	..	..	..	..	..	..	..
TOTAL	**9.5**	**13.2**	**18.4**	**3.4**	**22.6**	**22.5**	**55.9**	**2.6**

BHILAI EXPANSION, BOKARO & NEW STEEL PLANTS

(Constructional & Operational Requirements from 1971 *to* 1980)

(In '000 tonnes)

	1975				1976			
	HA	HG	LG	PL	HA	HG	LG	PL
FIREBRICKS								
BHILAI—Expansion								
(a) Constructional	..	1.9	1.9	1.8	..	0.9	0.9	1.0
(b) Operational	..	..	..	..	..	..	..	..
BOKARO								
Steel Ingot Prodn. (In million tonnes)	..	1.02	..	..	..	1.4	..	..
(a) Constructional	..	0.3	2.5	..	..	..	..	..
(b) Operational	0.8	15.0	8.3	1.0	1.1	20.6	11.3	1.4
SALEM	..	..	..	..	..	..	..	..
VIZAG								
(a) Constructional	6.5	3.5	12.0	..	6.5	3.5	18.0	..
(b) Operational	0.4	10.0	2.8	0.5	0.7	18.61	5.0	0.9
HOSPET								
Steel Ingot Prodn. (In Million Tonnes)	..	..	..	..	..	..	..	..
(a) Constructional	6.5	3.5	18.0	..	6.5	3.5	18.0	..
(b) Operational	..	..	..	..	..	..	..	..
NSP I								
Steel Ingot Prodn. (In million tonnes)	..	..	..	..	..	..	..	..
(a) Constructional	6.5	3.5	18.0	..	6.5	3.5	18.0	..
(b) Operational	..	..	..	..	..	..	..	..
NSP II								
Steel Ingot Prodn. (In Million tonnes)	..	..	..	..	..	..	..	..
(a) Constructional	..	..	..	..	6.5	3.5	18.0	..
(b) Operational	..	..	..	..	..	..	..	..
NSP III								
Steel Ingot Prodn. (In Million tonnes)	..	..	..	..	..	..	..	..
(a) Constructional	..	..	..	..	..	..	..	..
(b) Operational	..	..	..	..	..	..	..	..
NSP IV								
Steel Ingot Prodn. (In Million tonnes)	..	..	..	..	..	..	..	..
(a) Constructional	..	..	..	..	..	..	..	..
(b) Operational	..	..	..	..	..	..	..	..
NSP V								
Steel Ingot Prodn. (In Million tonnes)	..	..	..	..	..	..	..	..
(a) Constructional	..	..	..	..	..	..	..	..
(b) Operational	..	..	..	..	..	..	..	..
TOTAL	20.7	37.7	69.5	3.3	27.8	54.1	89.2	3.3

BHILAI EXPANSION, BOKARO & NEW STEEL PLANTS

(*Constructional & Operational Requirements from* 1971 *to* 1980)

(In '000 tonnes)

	1977				1978			
	HA	HG	LG	PL	HA	HG	LG	PL
FIREBRICKS								
BHILAI—Expansion								
(a) Constructional	..	..	..	..	..	..	..	..
(b) Operational	0.9	29.8	6.2	1.1	1.0	26.9	7.3	1.3
BOKARO								
Steel Ingot Prodn. (In million tonnes)	..	1.8	..	..	..	2.075	..	..
(a) Constructional	..	..	..	..	..	..	..	..
(b) Operational	1.4	26.5	14.6	1.8	1.7	0.5	16.8	2.1
SALEM	..	..	..	..	..	..	..	..
VIZAG								
(a) Constructional	0.5	15.9	..	..	3.0	2.0	9.0	..
(b) Operational	0.8	20.7	5.6	1.0	1.2	30.6	8.4	1.5
HOSPET								
Steel Ingot Prodn. (In million tonnes)	..	1.0	..	..	..	1.5	..	..
(a) Constructional	0.5	1.5	9.0	..	3.0	2.0	9.0	..
(b) Operational	0.8	20.7	5.6	1.0	1.2	30.6	8.4	1.5
NSP I								
Steel Ingot Prodn. (In Million tonnes)	..	..	..	..	..	1.0	..	..
(a) Constructional	6.5	3.5	18.0	..	3.5	1.5	9.0	..
(b) Operational	..	..	..	..	0.8	20.7	5.6	1.0
NSP II								
Steel Ingot prodn. (In Million Tonnes)	..	..	..	..	..	..	..	..
(a) Constructional	6.5	3.5	18.0	..	6.5	3.5	18.0	..
(b) Operational	..	..	..	..	..	..	..	..
NSP III								
Steel Ingot Prodn. (In million tonnes)	..	..	..	..	..	..	..	..
(a) Constructional	6.5	3.5	18.0	..	6.5	3.5	18.0	..
(b) Operational	..	..	..	..	..	..	..	..
NSP IV								
Steel Ingot Prodn. (In million tonnes)	..	..	..	..	..	..	..	..
(a) Constructional	..	..	..	..	..	..	..	..
(b) Operational	..	..	..	..	6.5	3.5	18.0	..
NSP V								
Steel Ingot Prodn. (In million tonnes)	..	..	..	..	..	..	..	..
(a) Constructional	..	..	..	..	..	..	..	..
(b) Operational	..	..	..	..	..	..	..	..
TOTAL	27.4	111.2	104.0	3.9	34.9	155.3	127.5	7.4

BHILAI EXPANSION; BOKARO & NEW STEEL PLANTS

(Constructional & Operational Requirements from 1971 *to* 1980)

(In '000 tonnes)

	1979				1980			
	HA	HG	LG	PL	HA	HG	LG	PL
FIREBRICKS								
BHILAI—Expansion								
(a) Constructional	..	..	..	..	..	..	..	..
(b) Operational	1.0	26.9	7.3	1.3	1.0	26.9	7.3	1.3
BOKARO								
Steel Ingot Prodn. (In million tonnes)	..	..	2.275	..	..	2.775	..	..
(a) Constructional	..	..	..	..	..	..	..	..
(b) Operational	2.1	1.8	3.4	18.4	2.2	40.8	22.5	2.8
SALEM	..	..	..	..	..	..	..	..
VIZAG								
(a) Constructional	..	..	..	..	..	..	..	..
(b) Operational	1.1	41.4	4.11	2.0	1.6	41.4	4.2	2.0
HOSPET								
Steel Ingot Prodn. (In million tonnes)	..	..	2.0	..	..	..	2.0	..
(a) Constructional	..	..	..	..	..	..	..	..
(b) Operational	1.6	41.4	11·2	2.0	1.6	41.4	11.2	2.0
NSP I								
Steel Ingot Prodn. (In million tonnes)	..	..	1.5	..	..	..	2.0	..
(a) Constructional	3.0	2.0	9.0	..	..	..	..	..
(b) Operational	1.2	30.6	8·4	1.5	1.6	41.4	11.2	2.0
NSP II								
Steel Ingot Prodn. (In million tonnes)	..	..	1.0	..	..	..	1.5	..
(a) Constructional	3.5	1.5	9.0	..	3.0	2.0	9.0	..
(b) Operational	0.8	20.7	5.6	1.0	1.2	30.6	8.4	1.5
NSP III								
Steel Ingot Prodn. (in million tonnes)	..	..	..	..	..	..	..	1.0
(a) Constructional	6.5	3.5	18.0	..	6.5	3.5	18.0	..
(b) Operational	..	..	..	..	0.8	20.7	5.6	1.0
NSP IV								
Steel Ingot Prodn. (In million tonnes)	..	..	..	..	..	..	..	..
(a) Constructional	6.5	3.5	18.0	..	6.5	3.5	18.0	..
(b) Operational	..	..	..	..	..	..	..	..
NSP V								
Steel Ingot Prodn. (In million tonnes)								
(a) Constructional	6.5	3.5	18.0	..	6.5	3.5	18.0	..
(b) Operational	..	..	..	..	..	..	..	..
TOTAL	**34.0**	**208.4**	**127.0**	**10.1**	**32.5**	**255.7**	**140.4**	**12.6**

BHILAI EXPANSION, BOKARO & NEW STEEL PLANTS BASIC BURNT

(Constructional & Operational Requirements from 1971 to 1980)

BASIC BURNT

(In '000 tonnes)

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
BHILAI EXPANSION										
(a) Constructional	...	...	...	1·5	1·5	...	...	...	...	...
(b) Operational	...	...	...	...	1·4	2·5	3·0	3·50	4·1	4·1
BOKARO :										
Steel ingot Production (in million tonnes)		0·202	0·60	0·80	1·02	1·4	1·8	2·075	2·275	2·775
(a) Constructional	1·0	1·1	1·0	1·0	0·8	...	...	...	...	...
(b) Operational	...	0·5	1·6	2·2	2·8	3·8	4·9	5·6	6·1	7·5
SALEM :	...	...	...	1·2	1·2	0·4	0·7	0·7	0·7	0·7
VIZAG	...	...	...	...	3·0	1·0	2·7	4·1	5·4	5·4
HOSPET										
Steel Ingot Prodn. (In million tonnes)	...	...	...	...	...	...	1·0	1·5	2·0	2·0
(a) Constructional	...	...	...	...	3·0	1·0	...	...	...	...
(b) Operational	...	...	...	...	...	...	2·7	4·1	5·4	5·4
NSP I :										
Steel Ingot Prodn. (in million tonnes)	...	...	...	...	...	...	...	1·0	1·5	2·0
(a) Constructional	...	...		...	3·0	1·0	...	...	...	...
(b) Operational	...	...	...	...	...	...	...	2·7	4·1	5·4
NSP II										
Steel Ingot Prodn. (In million tonnes)	...	...	...	...	...	...	...	...	1·0	1·5
(a) Constructional	...	...	...	...	...	...	3·0	1·0	...	...
(b) Operational	...	...	...	...	...	...	...	...	2·7	4·1
NSP III :										
Steel Ingot Prodn. (In million tonnes)	...	...	...	...	...	...	...	...	...	1·0
(a) Constructional	...	...	...	...	...	...	...	3·0	1·0	...
(b) Operaitonal	...	...	...	...	...	...	...	...	...	2·7
NSP IV :										
Steel Ingot Prodn. (In million tonnes)	...	...	...	...	...	...	...	...	...	...
(a) Constructional	...	...	...	...	...	...	...	...	3·0	1·0
(b) Operational	...	...	...	...	...	...	...	...	...	...
NSP V:										
Steel Ingot Prodn. (In Million tonnes)	...	...	...	...	...	...	...	...	...	...
(a) Constructional	...	...	...	...	...	...	...	...	...	3·0
(b) Operational	...	...	...	...	...	...	...	...	...	...
TOTAL	1·0	1·6	2·6	5·9	13·7	11·7	18·0	24·7	32·5	39·3

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BHILAI EXPANSION, BOKARO & NEW STEEL PLANTS

(Constructional & Operational Requirements from 1971 to 1980)

SILICA

(In '000 tonnes)

		1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
BHILAI	CO	...	...	...	...	...	...	...	...	...	...
	Others	...	...	...	...	...	...	...	...	...	...
BOKARO	CO	2·0	15·0	10·0	10·0	2·0	...	...	...	...	...
	Others	...	0·5	...	0·5	0·5	0·5	6·5	0·5	0·5	0·5
SALEM	CO	...	...	...	...	...	...	...	...	...	...
	Others	...	...	...	...	...	...	...	...	...	...
VIZAG	Co	...	...	...	22·5	22·5	...	...	...	...	...
	Others	...	...	...	...	...	0·5	...	...	...	...
HOSPET	CO	...	...	...	21·5	21·5	...	...	...	...	...
	Others	...	...	...	...	...	0·5	...	...	...	...
NSP I	CO	...	...	...	...	21·5	21·5	...	...	...	...
	Others	...	...	...	...	...	...	0·5	...	...	...
NSP II	CO	...	...	...	...	...	21·5	21·5	...	...	...
	Others	...	...	...	...	...	...	...	0·5	...	...
NSP III	CO	...	...	...	...	...	...	21·5	21·5	...	...
	Others	...	...	...	...	...	...	...	...	0·5	...
NSP IV	CO	...	...	...	...	...	...	...	21·5	21·5	...
	Others	...	...	...	...	...	...	...	...	...	0·5
NSP V	CO	...	...	...	...	...	...	...	...	21·5	21·5
	Others	...	...	...	...	...	...	...	...	...	...
TOTAL	CO	2·0	15·0	10·0	54·0	68·0	43·0	43·0	43·0	43·0	21·5
	Others	...	0·5	...	0·5	...	1·5	1·0	1·0	1·0	1·0

LIQUID METAL PRODUCTION—FORWARD ESTIMATE 71-80

Electric Steel Production—Exclusive of ASP/MISL/Salem

(In '000 tonnes)

	I Total All Grades	II Alloy Steel	III (Steel castings)					Carbon Steel
			Captive	Job	Rolls	Grinding media etc.	Total	
1971	958	200	158	165	16	21	360	378
1972	1371	260	161	170	16	21	368	743
1973	1549	287	161	180	16	21	378	884
1974	1724	299	161	210	16	21	408	1017
1975	1904	*344	161	210	16	21	408	1152
1976	2120	375	171	220	18	22	431	1314
1977	2370	400	186	230	20	23	459	1511
1978	2670	400	206	240	22	24	492	1778
1979	2970	400	220	250	24	25	519	2051
1980	3270	400	240	260	30	26	556	2314

[*includes Bihar Alloys]

OPERATIONAL REQUIREMENTS OF REFRACTORIES (EXCLUDING REQUIREMENTS OF MISL, ASP & SALEM)

Electric Furnace Steel

(In '000 tonnes)

		1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
STEEL PRODN.											
(a) Alloy steel		200	260	287	299	344	375	400	400	400	400
(b) Carbon steel		378	743	884	1017	1152	1314	1511	1778	2051	2314
(c) Steel castings inclusive of captive Rolls Grinding Media		360	368	378	408	408	431	459	492	519	556
All grades		958	1371	1549	1724	1904	2120	2370	2670	2970	3270
REFRACTORIES											(In Tonnes)
Types	*Norms*										
I. Dry fireclay & high alumina	(a) 18 Kg/t	3600	4680	5166	5382	6192	6750	7200	7200	7200	7200
	(b) 16 Kg/t	6048	11888	14144	16272	18432	4024	24176	28448	32816	37024
	(c) 16 Kg/t	5760	5888	6048	6528	6528	6896	7344	7872	8304	8896
		15408	22456	25358	28182	31152	34670	38720	43520	48320	53120
II. Basic Bricks	(a) 14 Kg/t	2800	3640	4018	4186	4830	5250	5600	5600	5600	5600
	(b) 8·6 kg/t	3250	6398	7602	8746	9907	11300	12994	15291	17639	19900
	(c) 8·6 kg/t.	3096	3164	3250	3508	3508	3706	3947	4231	4463	4782
		9146	13202	14870	16440	18245	20256	22541	25122	27702	30282
III. Silica bricks	(a) 6·0 kg/t (b) 6·0 kg/t (c) 6·0 kg/t.	5749	8226	9294	10344	11424	12720	14220	16020	17820	19620
IV. Mortars	10% of brick weight										
Fireclay		1540	2250	2535	2820	3120	3470	3870	4350	4830	5600
Basic		910	1320	1490	1640	1820	2020	2250	2510	2770	3030
Silica		570	820	930	1030	1140	1270	1420	1600	1780	1960
		3020	4390	4955	5490	6080	6760	7570	8460	9380	19590
V. Masses, castables Granulate Refractories		670	960	1080	1217	1330	1480	1660	1870	2080	2290

REQUIREMENTS OF REFRACTORIES FOR NEW CONSTRUCTION

(Excludes Salem, including Bihar, addition to MUSCO)

Electric Furnace Steel

(In '000 tonnes

	Norms	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Additional Steel production from new units											
Alloy		...	60	27	12	45	31	25	...	...	...
Carbon Steel Castings		300	373	151	163	135	185	125	300	340	300
		300	433	178	175	180	216	150	300	340	300
TYPES OF REFRACTORIES											
	Norms								(In Tonnes)		
Fireclay & inclusive of High Alumina	5 Kg/t	1500	2165	890	875	900	1080	750	1500	1700	1600
I. Basic	1·2 Kg/t	360	519	213	210	216	259	180	360	408	360
II. Silica	0·6 Kg/t	180	259	106	105	108	132	90	180	204	180
III. Mortar	10% Brick weight										
Fireclay		150	215	90	90	90	110	75	150	170	150
Basic		36	50	20	20	20	25	20	36	40	36
Silica		18	25	10	10	16	15	10	18	20	18
		204	290	120	120	120	150	105	204	230	204
IV. Masses Castables Granulated Refractories		21	30	12	12	12	13	10	21	23	21

ANNEXURE G

ANNEXURE 'G'

Estimated Yearwise Steel Production from 1971 to 1985

(In Million Tonnes)

S. No.	Description of Steel Plant	YEAR 1971	1972	1973	1974
1.	BHILAI STEEL PLANT	2·2	2.4	2.5	2.5
2.	DURGAPUR STEEL PLANT	1.15	1.3	1.6	1.6
3.	ROURKELA STEEL PLANT	1.6	1.8	1.8	1.8
4.	ALLOY STEEL PLANT	.9070	.104820	.10496	.10516
5.	TATA IRON & STEEL CO.	1.8	1.8	2.0	2.0
6.	INDIAN IRON AND STEEL CO.	1.0	1.3	1.3	1.3
7.	MYSORE IRON & STEEL CO.	.16	.15	.15	.15
8.	BOKARO STEEL LIMITED	..	.202	.60	.80
9.	SALEM	..	..	..	..
10.	HOSPET	..	..	..	..
11.	VISAKHAPATNAM	..	..	..	..
12.	NEW STEEL PLANT No. 1	..	..	..	..
13.	NEW STEEL PLANT No. 2	..	..	..	..
14.	NEW STEEL PLANT No. 3	..	..	..	..
15.	NEW STEEL PLANT No. 4	..	..	..	..
16.	NEW STEEL PLANT No. 5	..	..	..	..
	TOTAL	**7.99**	**9.05**	**10.05**	**10.25**
	Steel Furnace Association (excluding MISL)	0.958	1.371	1.549	1.724

S. No.	Description of Steel Plant	YEAR 1975	1976	1977	1978
1.	BHILAI STEEL PLANT	3.2	3.4	3.6	3.8
2.	DURGAPUR STEEL PLANT	1.6	1.6	1.6	1.6
3.	ROURKELA STEEL PLANT	1.8	1.8	1.8	1.8
4.	ALLOY STEEL PLANT	.10516	.10516	.10516	.10516
5.	TATA IRON & STEEL CO.	2.0	2.0	2.0	2.0
6.	INDIAN IRON & STEEL CO.	1.3	1.3	1.3	1.3
7.	MYSORE IRON & STEEL	.15	.15	.15	.15
8.	BOKARO STEEL LIMITED	1.02	1.4	1.8	1.075
9.	SALEM	..	.15	.25	.25
10.	HOSPET	..	..	1.0	1.5
11.	VISAKHAPATNAM	..	..	1.0	1.5
12.	NEW STEEL PLANT NO. 1	..	..	..	1.0
13.	NEW STEEL PLANT NO. 2	..	..	..	..
14.	NEW STEEL PLANT NO 3	..	..	..	..
15.	NEW STEEL PLANT NO. 4	..	..	..	..
16.	NEW STEEL PLANT NO. 5	..	..	..	..
	TOTAL	**10.47**	**11.0**	**13.50**	**15.77**
	STEEL FURNACE ASSOCN	1.904	2.120	2.370	2.670

REMARKS : Steel Production of Bokaro increases from 2.275 to 4 from 1979 to 1983.

20—1 D of S/ND/72

BHILAI EXPANSION, BOKARO & NEW STEEL PLANTS

Estimated Yearwise Steel Production from 1971 to 1985

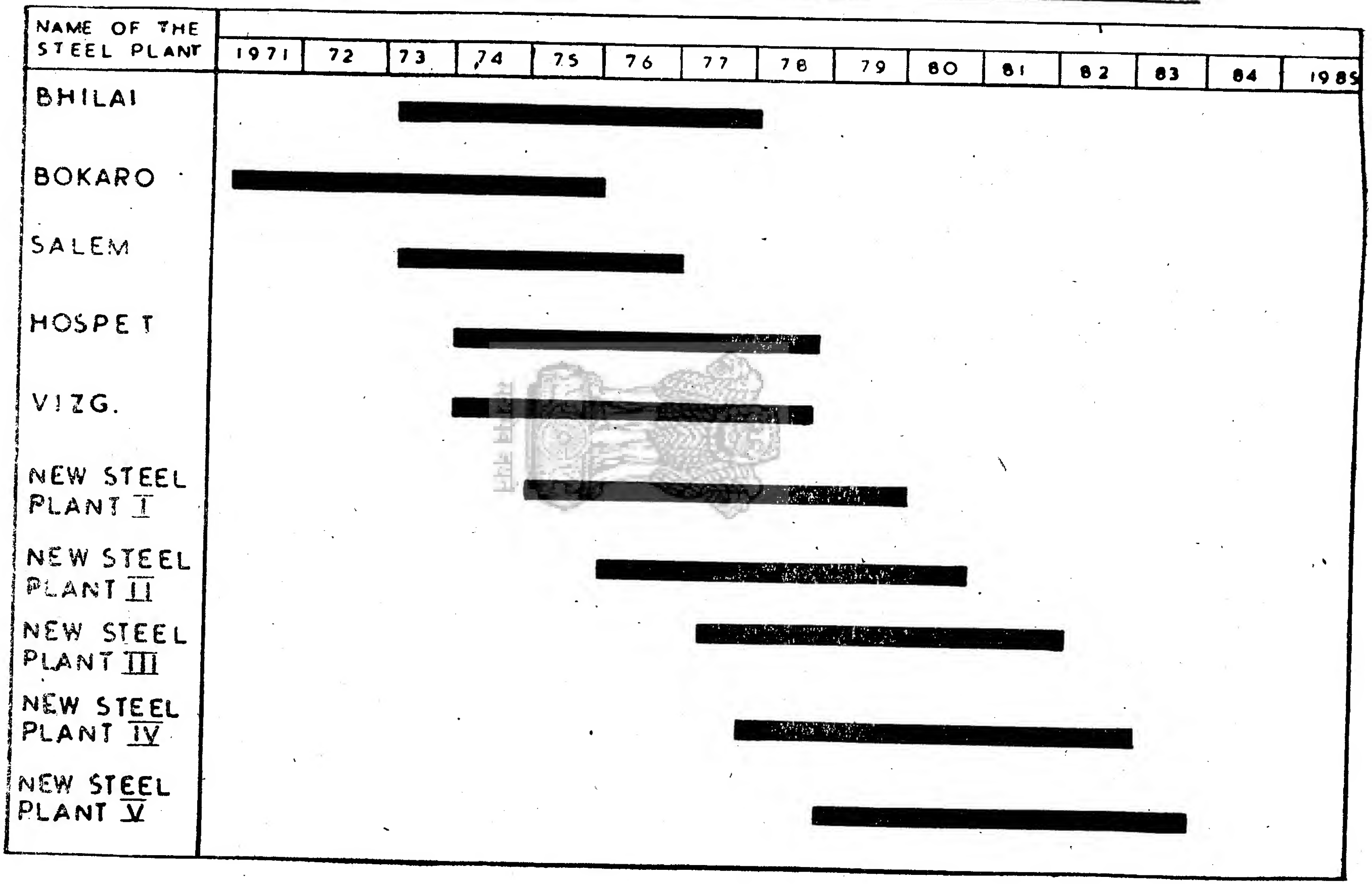
(In Million Tonnes)

S. No.	Description of Steel Plant	YEAR 1979	1980	1981	1982
1.	BHILAI STEEL PLANT	4.0	4.0	4.0	4.0
2.	DURGAPUR STEEL PLANT	1.6	1.6	1.6	1.6
3.	ROURKELA STEEL PLANT	1.8	1.8	1.8	1.8
4.	ALLOY STEEL PLANT	.10516	.10516	.10516	.10516
5.	TATA IRON & STEEL CO.	2.0	2.0	2.0	2.0
6.	INDIAN IRON & STEEL CO.	1.3	1.3	1.3	1.3
7.	MYSORE IRON & STEEL	.15	.15	.15	.15
8.	BOKARO STEEL LIMITED	2.275	2.275	3.275	3.775
9.	SALEM	.25	.25	.25	.25
10.	HOSPET	2.0	2.0	2.0	2.0
11.	VISAKHAPATNAM	2.0	2.0	2.0	2.0
12.	NEW STEEL PLANT NO. 1	1.5	2.0	2.0	2.0
13.	NEW STEEL PLANT NO. 2	1.0	2.0	2.0	2.0
14.	NEW STEEL PLANT NO. 3	..	1.0	1.5	2.0
15.	NEW STEEL PLANT NO. 4	..	..	1.0	1.5
16.	NEW STEEL PLANT NO. 5	..	..	..	1.0
	TOTAL	**18.48**	**20.98**	**23.48**	**25.98**
	STEEL FURNACE ASSOCN.	2.970	3.270	Not available.	

S. No.	Description of Steel Plant	YEAR 1983	1984	1985
1.	BHILAI STEEL PLANT	4.0	4.0	4.0
2.	DURGAPUR STEEL PLANT	1.6	1.6	1.6
3.	ROURKELA STEEL PLANT	1.8	1.8	1.8
4.	ALLOY STEEL PLANT	.10516	.10516	.10516
5.	TATA IRON & STEEL CO.	2.0	2.0	2.0
6.	INDIAN IRON & STEEL CO.	1.3	1.3	1.3
7.	MYSORE IRON & STEEL CO.	.15	.15	.15
8.	BOKARO STEEL LTD.	4.00	4.00	4.00
9.	SALEM	.25	.25	.25
10.	HOSPET	2.0	2.0	2.0
11.	VISAKHAPATNAM	2.0	2.0	2.0
12.	NEW STEEL PLANT NO. 1	2.0	2.0	2.0
13.	NEW STEEL PLANT NO. 2	2.0	2.0	2.0
14.	NEW STEEL PLANT NO. 3	2.0	2.0	2.0
15.	NEW STEEL PLANT NO. 4	2.0	2.0	2.0
16.	NEW STEEL PLANT NO 5	1.5	2.0	2.0
	TOTAL	**27.20**	**27.70**	**27·70**
	STEEL FURNACE ASSOCN.	Not available.		

REMARKS: Steel Production of Bokaro increases from 2.275 to 4 from 1979 to 1983.

ASSUMED CONSTRUCTION SCHEDULE OF STEEL PLANTS



ANNEXURE 'J'

AVAILABILITY OF REFRACTORIES

(As furnished by IRMA)

Fireclay (Including High Alumina)

(In tonnes)

Manufacturer	Installed capacity	Production capacity	Actual production in 1970
1. Kumardhubi Fireclay	100000	85000	53,110
2. Orissa Cement	40000	39626	32,800
3. Belpahar	40000	40000	34,233
4. Behar F/B	50000	31000	13,552
5. India F/B	60000	40000	34,591
6. Burn & Co.	84500	84500	62,132
7. Reliance F/B	72000	50250	16,750
8. Associated Cement	18960	18960	17,927
9. Jharia F/B	30000	25000	6,300
10. Maithon Ceramic	21725	18100	4,450
11. Jauhar F/B	21150	14150	11,320
12. India Refrs.	21300	21300	21,200
13. Hind Refr.	12192	12192	11,983

Manufacturer	Estimated Production				Wet	Dry
	1971	1972	1973	1975		
1. Kumardhubi Fireclay	59,600	61750	74250	80000	12000	Balance
2. Orissa Cement	37,000	48000	39000	40000	5%	95%
3. Belpahar	40000	44000	44000	All dry	Nil	100%
4. Behar F/B	20900	23900	23900	23900	100%	Nil
5. India F/B	34180	40000	50000	60000	Nil	100%
6. Burn & Co.	70000	70000	70000	70000	Nil	15000 20000
7. Reliance F/B	40000	40000	40000	50000	100%	Nil
8. Associated Cement	19560	19560	10560	..	..	..
9. Jharia F/B	10000	13000	15000	15000	100%	Nil
10. Maithon Ceramic	12100	12500	16100	16000	100%	..
11. Jauhar F/B	13670	13750	13850	14000	100%	..
12. India Refr.	20000	21400	25300	25000	10%	90%
13. Hind Refr.	13000	14000	14000	14000	100%	..

AVAILABILITY OF REFRACTORIES

(As furnished by IRMA)

Silica (In tonnes)

Manufacturer	Installed capacity	Production capacity	Actual production in 1970
1. Kumardhubi F/Clay	24000	..	17,300
2. Orissa Cement	22353	22353	10,500
3. Belpahar	20000	12000	8,550
4. Behar F/B	10000	9000	5,906
5. Burn & Co.	17000	17000	12,411
6. Reliance F/B	..	1305	435

	Estimated production				Wet	Dry
	1971	1972	1973	1975	Coke Ovens	Others
1. Kumardhubi F/Clay	20000	21500	21500	22000	6000	1800
2. Orissa Cement	12000	17000	23000	23000	70%	30%
3. Belpahar	12000	18000	20000	20000	70%	30%
4. Behar F/B	6300	8500	8500	8500	20%	75%
5. Burn & Co.	17000	17000	17000	17000	12½%	87½%
6. Reliance F/B	Can be increased by 20% of 1970 if orders are received.				Nil	Rest

BASIC

Manufacturer	Installed capacity	Production capacity	Actual production in 1970
1. Belpahar	50000	38000	36383
2. Orissa Cement	48770	48770	43400
3. Burn & Co.	18000	18000	8058
4. TISCO	3500		

Manufacturer	Estimated production				Burnt	Chemically bonded
	71	72	73	75		
1. Belpahar	40000	45000	50000		38000	12000
2. Orissa Cement	55000	65000	After 75000 licence for 20000		42000	12000
3. Burn & Co.	11200	18000	..		13000	5000
4. TISCO	..	..	..		3500	..

ANNEXURE 'K'

ANNEXURE 'K'

Availability of Fireclay & High Alumina Bricks During 1971 to 1980 from Refractory Industry

	1971			1972		
	HA HG	LG	PL	HA HG	LG	PL
14 Units (Covered in detail)	95.8	115.4	146.9	122.4	125.4	151.7
HSL	..	..	..	..	..	..
Burn & Co.	..	..	39.5	..	..	39.5
Iswar	..	..	..	..	..	..
Asian	..	..	..	9.0	..	..
MIDCO	..	..	..	..	..	..
G&D Co.	..	..	..	..	..	..
	95.8	115.4	186.4	131.4	125.4	191.2

	1973			1974		
	HA HG	LG	PL	HA HG	LG	PL
14 Units (Covered in detail)	149.1	135.6	156.6	163.6	138.4	158.1
HSL	..	..	..	..	..	..
Burn & Co.	..	..	39.5	..	..	39.5
Iswar	8.0	..	..	10.0	..	..
Asian	18.0	..	..	25.0	..	..
MIDCO	..	..	..	..	..	..
G&D Co.	..	..	..	8.0	..	..
	175.1	135.6	196.1	206.6	138.4	197.6

	1975			1976		
	HA HG	LG	PL	HA HG	LG	PL
14 Units (Covered in detail)	178.1	141.2	159.6	178.1	141.2	159.6
HSL	19.3	7.8	2.8	25.1	10.0	3.9
Burn & Co.	..	..	39.5	..	..	39.5
Iswar	10.0	..	..	10.0	..	..
Asian	25.0	..	..	25.0	..	..
MIDCO	40.0	..	..	50.0	..	..
G&D Co.	10.0	..	..	10.0	..	..
	282.4	149.0	202.1	298.2	151.2	203.0

MIDCO: Mysore State Industrial Development Corporation:
G&D CO. Gannon & Dunkerley Co.

Availability of Fireclay & High Alumina Bricks During 1971 to 1980 from Refractory Industry

	1977			1978		
	HA HG	LG	PL	HA HG	LG	PL
14 Units (Covered in detail)	178.1	141.2	153.6	178.1	141.2	159.6
HSL	30.9	12.4	4.7	30.9	12.4	4.7
Burn & Co.	..	..	39.5	..	..	39.5
ISWAR	10.0	..	..	10.0	..	..
ASIAN	25.0	..	..	25.0	..	..
MIDCO	60.0	..	..	60.0	..	..
G&D Co.	10.0	..	..	10.0	..	..
	304.0	153.6	203.8	304.0	153.6	203.8

	1979			1980		
	HA HG	LG	PL	HA HG	LG	PL
14 Units (Covered in detail)	178.1	141.2	159.6	178.1	141.2	159.6
HSL	30.9	12.4	4.7	30.9	12.4	4.7
Burn & Co.	..	..	39.5	..	..	39.5
ISWAR	10.0	..	..	10.0	..	..
ASIAN	25.0	..	..	25.0	..	..
MIDCO	60.0	..	..	60.0	..	..
G&D Co.	10.0	..	..	10.0	..	..
	304.0	153.6	203.8	304.0	153.6	203.8

MIDCO : Mysore State Industrial Development Corporation.
GNDCO : Gannon & Dunkerley Co

Availability of Basic Refractories from 1971-1985

YEAR	1971		1972		1973		1974	
Type	B	CB	B	CB	B	CB	B	CB
Name of plant								
Belpahar Refractories Limited	20	20	22.5	20	25	20	29.0	18.5
Orissa Cement Limited	30	25	35	25	40	25	41.0	29
Burn & Co.	8.6	3.0	8.6	3	8.6	3	8.6	3
Orissa Industries Ltd.	..	..	..	..	..	..	..	6.0
Hind Ceramics	..	..	..	..	..	6.0	..	8
Mysore State Industrial Development Corporation	..	..	..	..	..	..	..	..
Hindustan Steel Ltd.	..	..	..	..	..	..	..	..
TOTAL	58.6	48	66.1	48	73.6	54	78.6	64.5

YEAR	1975		1976		1977		1978	
Type	B	CB	B	CB	B	CB	B	CB
Name of Plant								
Belpahar Refractories Limited	38	12	38	12	38	12	38	12
Orissa Cement Limited	42	33	42	33	42	33	42	33
Burn & Co.	8.6	3	8.6	3	8.6	3	8.6	3
Orissa Industries Limited	..	8	..	32	..	32	..	32
Hind Ceramics	..	8	..	8	..	8	..	8
Mysore State Industrial Development Corporation	30	..	40	..	40	..	40	..
Hindustan Steel Limited	12.75	2.25	16.6	2.9	20.4	3.6	20.4	3.6
TOTAL	131.4	66.25	145.2	90.9	149	91.6	149.0	91.6

YEAR	1979		1980		1981		1982	
Type	B	CB	B	CB	B	CB	B	CB
Name of Plant								
Belpahar Refractories Limited	38	12	38	12	38	12	38	12
Orissa Cement Limited	42	33	42	33	42	33	42	33
Burn & Co.	8.6	3	8.6	3	8.6	3	8.6	3
Orissa Industries Limited		32	..	32	..	32	..	32
Hind Ceramics	..	8	..	8	..	8	..	8
Mysore State Industrial Development Corporation	40	..	40	..	40	..	40	..
Hindustan Steel Limited	20.4	3.6	20.4	3.6	20.4	3.6	20.4	3.6
TOTAL	149	91.6	149	91.6	149	91.6	149	91.6

NOTE.—In projecting the demand constructional and operational requirements for steel capacity of 2 million tonnes per annum beyond 1985 are taken into account.

Availability of Basic Refractories from 1971—1985

YEAR	1983		1984		1985	
TYPE	B	CB	B	CB	B	CB
Name of plant						
Belpahar Refractories Ltd.	38	12	38	12	38	12
Orissa Cement Ltd.	42	33	42	33	42	33
Burn & Co.	8·6	3	8.6	3	8·6	3
Orissa Industries Ltd.		32		32		32
Hind Ceramics		8		8		8
Mysore State Industrial Dev. Corporation	40		40		40	
Hindustan Steel Limited.	20.4	3.6	20.4	3.6	20·4	3.6
TOTAL	149	91.6	149	91.6	149	91.6

NOTE: In projecting the demand constructional and operational requirements for steel capacity of 2 million tonnes per annum beyond 1985 are taken into account.

Availability of SILICA Refractories During 1971 to 1985 from Refractory Industry

	1971		1972		1973		1974	
	CO	OT	CO	OT	CO	OT	CO	OT
BRL	5.0	7.0	9.5	6.5	14.0	6.0	14.0	6.0
OCL	6.5	5.5	10.75	6.75	15.0	8.0	15.5	7.5
KFS	4.0	16.0	5.0	15.5	6.0	15.0	6.0	15.5
BEHAR	1.8	5.7	1.8	5.35	4.9	5.0	4.0	5.0
Burn & Co.	0.1	12.3	0.1	12.3	0.1	12.3	0.1	12.3
HSL	..	..	..	..	..	..	..	..
MSIDC	..	..	..	..	..	..	..	..
TOTAL	17.4	46.5	27.15	46.4	39.1	46.3	39.6	46.3

	1975		1976		1977	
	CO	OT	CO	OT	CO	OT
BRL	14.0	6.0	14.0	6.0	14.0	6.0
OCL	16.1	6.9	16.1	6·9	16.1	6.9
KFS	6.0	16.0	6.0	16.0	6.0	16.0
BEHAR	4.0	5.0	4.0	5.0	4.0	5.0
Burn & Co.	0.1	12.3	0.1	12.3	0.1	12.3
HSL	4.0	1.0	5.2	1.3	6.4	1.6
MSIDC	8.0	8.0	8.0	8.0	8.0	8.0
TOTAL	52.2	55.2	53.7	53.3	54.9	55.6

NOTE: In projecting the demand constructional and operational requirements for steel capacity of 2 million tonnes per annum beyond 1985 are taken into account.

BRL : Belpahar Refractories Ltd.

OCL : Orissa Cement Ltd.

OIL : Orissa Industries Ltd.

HC : Hind Ceramics.

MSIDC : Mysore State Industrial Development Corpn.

HSL : Hindustan Steel Ltd.

Availability of Silica Refractories During 1971 to 1985 from Refractory Industry

	1978		1979		1980		1981	
	CO	OT	CO	OT	CO	OT	CO	OT
BRL	14.0	6.0	14.0	6.0	14.0	6.0	14.0	6.0
OCL	16.1	6.9	16.1	6.9	16.1	6.9	16.1	6.9
KFS	6.0	16.0	6.0	16.0	6.0	16.0	6.0	16.0
BEHAR	4.0	5.0	4.0	5.0	4.0	5.0	4.0	5.0
BURN & CO.	0.1	12.3	0.1	12.3	0.1	12.3	0.1	12.3
HSL	6.4	1.6	6.4	1.6	6.4	1.6	6.4	1.6
MSIDC	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
TOTAL	54.9	55.6	54.9	55.6	54.9	55.6	54.9	55.6

	1982		1983		1984		1985	
	CO	OT	CO	OT	CO	OT	CO	OT
BRL	14.0	6.0	14.0	6.0	14.0	6.0	14.0	6.0
OCL	16.1	6.9	16.1	6.9	16.1	6·9	16.1	6.9
KFS	6.0	16.0	6.0	16.0	6.0	16.0	6.0	16.0
BEHAR	4.0	5.0	4.0	5.0	4.0	5.0	4.0	5.0
BURN & CO	0.1	12.3	0.1	12.3	0.1	12.3	0.1	12.3
HSL	6.4	1.6	6.4	1.6	6.4	1.6	6.4	1.6
MSIDC	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
TOTAL	54.9	55.6	54.9	55.6	54.9	55.6	54.9	55.6

LEGEND:

BRL : Belpahar Refractories Ltd.
OCL : Orissa Cement Ltd.
KFS : Kumardhubi Fireclay & Silica Works.
BEHAR : Behar Firebricks & Potteries Ltd.
HSL : Hindustan Steel Ltd.
MSIDC : Mysore State Industrial Development Corporation.

NOTE: In projecting the demand constructional and operational requirements for steel capacity of 2 million tonnes per annum beyond 1985 are taken into account.

Availability of DEAD BURNT Magnesite During 1971—85

Name of the Plant	1971	1972	1973	1974
Dalmia	36.0	54.0	72.0	72.0
Belpahar	25.0	35.0	42.0	53.0
Burn & Co.	12.0	12.0	12.0	12.0
TISCO	5.0	5.0	5.0	5.0
TOTAL	78.0	106.0	131.0	142.0

Name of the Plant	1975	1976	1977
Dalmia	72.0	72.0	72.0
Belpahar	55.0	55.0	55.0
Burn & Co.	12.0	12.0	12.0
TISCO	5.0	5.0	5.0
TOTAL	144.0	144.0	144.0

Name of the Plant	1978	1979	1980	1981
Dalmia	72.0	72.0	72.0	72.0
Belpahar	55.0	55.0	55.0	55.0
Burn & Co.	12.0	12.0	12.0	12.0
TISCO	5.0	5.0	5.0	5.0
TOTAL	144.0	144.0	144.0	144.0

Name of the Plant	1982	1983	1984	1985
Dalmia	72.0	72.0	72.0	72.0
Belpahar	55.0	55.0	55.0	55.0
Burn & Co	12.0	12.0	12.0	12.0
TISCO	5.0	5.0	5.0	5.0
TOTAL	144.0	144.0	144.0	144.0

ANNEXURE 'L'

ANNEXURE 'L'

REPORT OF THE EXPERT GROUP WHO MADE AN ASSESSMENT OF AVAILABILITY OF REFRACTORIES FOR STEEL INDUSTRY

In pursuance of the decision taken in the Refractory Committee Meeting held at Calcutta on the 9th and 10th of August, 1971, a team consisting of the following members, visited the 9 Refractory Units as per Annexure I.

In the panel meeting on 8th and 9th September, when the report of the Committee came for discussion, it was decided that the team should visit the remaining five units of the listed 14 Refractory Plants. Accordingly the 5 plants at Annexure I-A were also visited. The report on these units is also enclosed.

Composition of Committee

1. Shri R.S.N. Iyer, Hindustan Steel Limited . . . . *Convenor*
2. Shri S.R. Khanna, Development Officer, DGTD . . . . . . *Member*
3. Shri M.H. Dalmia, Orissa Cement Limited, Rajgangapur . . . . *Member*
4. Shri K.S. Swaminathan, Tata Iron & Steel Co. Limited . . . . . *Member*
5. Shri K.K. Dandhopadhyaya, Hindustan Steel Limited, Rourkela Steel Plant . *Member*
6. Shri A. Sen, Kumardhubi Fireclay & Silica Works . . . . . *Member*

TERMS OF REFERENCE OF THE COMMITTEE

i) To assess the capacity of the units for manufacturing various types of refractories with particular reference to refrctories required by the steel plants.

ii) The capacity of the units to switch over from plastic to dry process wherever applicable.

iii) Future programme of manufacture of refractories required by the Steel Plants.

Keeping in view the above terms of refercnce, findings of the team relating to individual plants are enclosed.

Annexure IV gives the total capacity of the 14 units under visit for production of fireclay, basic and silica refractories.

1. India Refractories Limited,
   Kulti, West Bengal.

2. Reliance Firebricks & Pottery Co. Ltd.
   Chanch,
   Distt. Dhanbad,
   Bihar.

3. Burn & Co. Ltd.,
   Gulfarbari,
   Bihar.

4. Behar Firebricks & Potteries Ltd.,
   Mugma,
   Distt. Dhanbad,
   Bihar.

5. Jharia Firebricks & Refractory Works Pvt.
   Limited, Dhansar,
   Distt. Dhanbad,
   Bihar.

6. Bharat Firebricks & Pottery Works Pvt.
   Limited, Jharia,
   Distt. Dhanbad,
   Bihar.

7. Kumardhubi Fireclay & Silica Works Ltd.,
   Kumardhubi,
   Distt. Dhanbad.
   Bihar.

8. Orissa Industries Limited,
   Lathikata,
   Rourkela-4,
   Orissa.

9. IFICO,
   Ramgarh.

10. Belpahar Refractories Limited,
    Belpahar.

11. Orissa Cement Limited, Rajgangpur.

12. Maithen Ceramics Limited, Maithen.

13. Janhar Firebricks Limited,
    Mugma.

14. Hind Refractories Limited,
    Durgapur.

I. India Refractories Ltd., Kulti

The licensed capacity of this unit is 36,000 tonnes presently manufacturing firebricks. The details of their production in 1970 and their anticipated production in coming years is mentioned in Annexure II-A.

The envisaged increase in production by 1973 is by dry process by installing additional presses, and one tunnel kiln and other auxiliary equipment. Additional investment on this account is around Rs. 45 lakhs.

The team doubted their capability to manufacture refractories for blast furnace in bulk till they get heavy duty presses. If action is initiated now, it should be possible to achieve the projected capacity for blast furnace refractories before 1975.

II. Reliance Firebricks

Date of visit: 31-8-1971

The licensed capacity of this unit is 72,000 tonnes presently manufacturing firebricks. Details of their production in 1970 and their projected production are given in Annexure II-a.

Present facilities are capable of manufacturing up to 50,000 tonnes of firebricks, but all by plastic process.

It was reported that they intended to go in for a new plant for manufacture of 22,000 tonnes of firebricks by dry process at a new site which was under examination. For this plant, they already possess the crushing-grinding equipment, the imported presses, components and construction drawings for tunnel kiln and drier including gas producer. It was understood that these have been lying idle with them since 1967. At that time the scheme could not materialise due to financial stringency and recession in the market.

The unit could instal with advantage the available dry presses at the existing site and it should be possible for them to switch over a substantial part of their plastic process production to dry process by using the rest of the equipment. The same presses could at a later date be shifted to the new site. The team has not included any availability from this plant by the Dry Process.

The team noted that this plant has good potential and has been supplying refractories in huge quantities to steel plants particularly the hollow wares.

III. Burn & Co. Limited

Date of visit: 1-9-1971

The licensed capacity of this unit is 30,000 tonnes and they are presently manufacturing firebricks.

Details of their production in 1970 and their projected production are given in Annexure II-a.

Their expected increase in production is by way of improvement in productivity and through fuller utilisation of their existing plant capacity. The Team agrees with their projected increased production.

This unit is functioning almost as a captive unit to IISCO, and their production pattern is guided by the demand pattern of IISCO. This is the reason that they have no plans to increase their proportion of dry process product.

IV. Behar Firebricks

The licensed capacity of this unit is 50,000 tonnes. The firm is engaged in manufacture of firebricks and silica bricks.

The past and the projected production are mentioned in Annexure II-a and II-b.

Firebricks

The increase in their production of firebricks is expected by installing balancing equipment. This would also enable them to increase their production by the dry process. They intend to go in for a continuous kiln and utilise some of the existing kilns for calcining the raw materials. The second part (1975) scheme depends on some imported components for which they intend to apply shortly for import licence. The team agrees with the proposed programme subject to their obtaining import licence and arranging finance.

Silica Bricks

The increase in production of silica bricks is by way of installing balancing equipment to be procured from indigenous sources. The firm will be in a position to increase their production of coke oven bricks conforming to the quality required by the Steel Plants.

V. Jharia Firebricks

Date of visit: 2-9-1971

Licensed capacity of this unit is 44,400 tonnes. They are presently manufacturing firebricks. Their past and projected productions have been summarised in Annexure II-a.

The proposed increase in their production is by installing additional presses for switch over to dry process. The firm has already submitted import application for processes.

They intend to increase their capacity further by setting up an independent production line based on dry process. A feasibility report for above is under preparation. As the firm could not indicate the capacity involved, the same has not been taken into account in the Annexure II-a.

VI. Bharat Firebricks & Potteries

Date of visit: 2-9-1971

This unit is in the Small Scale Sector and is manufacturing firebricks. They intend to increase their production by installing an additional flow-line with indigenous equipment. The unit appeared to be conscious of the change of manufacturing process and was taking steps to increase their production by dry process.

VII. Kumardhubi Fireclay & Silica Works Limited

Date of visit: 3-9-1971

Licensed capacity of this Unit is 135,000 tonnes. They are presently manufacturing firebricks, silica bricks and speciality products.

Past and projected production in coming years is given in Annexures II-a and II-b.

Firebricks

They have a programme to equip themselves to meet the demands of the most sophisticated types of firebricks required by steel and other industries. The programme includes a new tunnel kiln capable of attaining temperature up to 1600°C. Additional heavy duty presses and other equipments are also proposed. They have already submitted import applications for the components of the tunnel kiln and the heavy duty presses. It was reported that their total financial outlay on this programme is of the order of Rs. 160 lakhs, out of which Rs. 60 lakhs have already been spent and the balance will be spent in the coming two years.

In the opinion of the Team the projected productions as given in the Annexure II are likely to be fulfilled subject to their obtaining import licences.

Silica

In the Silica section they intend to improve the production of coke oven silica bricks in terms of quantity and quality. The proposed financial outlay for this programme is about Rs. 70 lakhs of which 2/3rd has already been spent. They have already submitted import application for the mixing mill and a heavy duty press.

VIII. India Firebricks & Insulation Co. Limited

Date of visit: 4-9-1971

The licensed capacity of the unit is 72,000 tonnes. They are presently manufacturing firebricks. Past and projected productions from this Unit are given in Annexure II-a.

The Unit has modern equipment and is capable of manufacturing refractories for the steel industry. They cannot increase the production for want of presses. The total number of heavy duty presses available with them is 8. They intend to go in for additional 18 heavy duty presses of which they have placed order for 4, which are likely to be available in the next year. Their import application for balance 14 presses is under consideration of DGTD. One tunnel kiln is under construction. This kiln is capable of attaining a temperature of 1600°C. Their total capital outlay for the proposed programme is estimated at Rs. 160 lakhs. This programme when implemented will enable them to produce 60,000 tonnes of firebricks, 9000 tonnes of silica bricks and 3,000 tonnes of basic bricks.

Subject to issue of import licence for the required number of heavy duty presses, the projected production as mentioned in the Annexure II-a may be achieved.

The team felt further that availability of silica and basic bricks from this unit may be doubtful in 1973 but could be expected by 1975. It was also felt that all of these presses may not be available for production and consequently production is estimated at 50,000 tonnes of firebricks in 1973.

IX Orissa Industries Limited

Date of visit: 6-9-1971

The licensed capacity of this unit is 38,000 tonnes. They are presently manufacturing firebricks.

Details of past and projected productions from this unit are mentioned in Annexure II-a.

They have a programme to install a new production line with a tunnel kiln, heavy duty presses and other balancing equipment. This kiln, it has been stated, will be available for production by April, 1973, but the Team felt that availability of this kiln might not be expected before October, 1973 and hence production in 1973 as per estimate of the Team is lower than that projected by Orissa Industries Ltd.

Their total capital outlay for this programme is to the tune of Rs. 120 lakhs.

During the discussions the Team learnt that Orissa Industries Ltd., has in hand a Letter of Intent for manufacture of 50,000 tonnes of basic bricks and specialities which they intend to put up in Latkata. This scheme as per the Company's estimate is likely to materialise by 1975.

X Jauhar Firebricks

Date of visit: 22-9-1971.

The licensed capacity of this unit is 24,000 tonnes for manufacturing firebricks.

Details of their production in 1970 and their anticipated production in the coming years are shown in Annexure II-a (Contd.).

During the first half of this year their total production is 7200 tonnes and their estimate for the year 1971 is 14500 tonnes.

They propose to increase their output by 2000 tonnes by 1973 with the installation of 2 Nos. Friction Screw presses (indigenous), construction of 2 additional round kilns of which ones already under construction, and extension of the existing ring chamber kiln by additional 4 chambers.

The present production of 1500 tonnes shown under dry-process is actually by semi dry process and hence this is shown under Plastic process.

With the installation of the proposed heavy duty presses, the availability of Low Grog bricks by dry process from 1973 onwards is considered feasible.

XI Maithan Ceramics Private Limited

Date of visit: 22-9-1971.

This unit is in small scale sector and is presently manufacturing firebricks and insulating bricks. They also make recuperator tubes both by slip casting and by extrusion.

So far all their production is by Plastic Process. During the first half of this year they have already produced 6350 tonnes and their estimated figure for the year 1971 is 14000 tonnes. The increase in production as compared to 1970 is due to installation of Bradley and Craren machine, new round kilns and other balancing equipments.

This unit appears to be conscious of the need for changeover from wet process to dry process and, in fact, they have started manufacture of small quantity of bricks by dry process. They have a programme to manufacture high grog bricks for which they have ordered crushing and grinding equipment as well as Friction Screw presses one of which is a 250 tonne Russian Friction Screw press. They also propose to have a chamber kiln with provision for oil firing.

According to the Company the total capital outlay for the above project is in the range of Rs. 12 lakhs.

High Alumina bricks are made mostly by Plastic Process and hence this is not shown under dry process. The team felt that in the absence of proper arrangement for fractionation, batching and heavy duty presses it will not be possible to produce good quality high grog bricks. Hence the entire tonnage shown by them against dry process has been shown as Low Grog.

XII Orissa Cement Limited

Date of visit: 17-9-1971

The total licensed capacity of this unit is 1,09,000 tonnes comprising of

39,000 tonnes firebricks
22,000 tonnes Silica bricks
48,000 tonnes Basic bricks.

Details of their production in 1970 and their anticipated production in the coming years is shown in Annexures II-a, II-b and II-c respectively for fireclay, silica and basic units.

Firebricks

Their actual production during the first six months of this year is 18200 tonnes and hence the projected figure of 37000 tonnes for the year 1971 is likely to be achieved. A marginal increase of 3000 tonnes is proposed by 1973 with the existing manufacturing facilities.

Silica

The existing manufacturing facilities of the Silica section is for a total output of approximately 12,000 tonnes with a product mix of 70% of Coke Oven shapes. They are doubling their capacity of Silica bricks manufacture by installing a separate plant. Civil work is well in progress. Construction of two ring chamber kilns similar to the existing ones has already started. They have also submitted import licence application for Simon Cone Crusher, Silica Mixing Mill and Heavy Duty presses.

It is reported that the proposed financial outlay for this Project is about Rs. 170 lakhs.

Basic

During the first half of this year the total production is 25600 tonnes comprising of 10,000 tonnes of burnt and 15,600 tonnes of chemically bonded basic bricks. The above burnt output was achieved from the No. 1 Tunnel Kiln only as the second tunnel kiln has been put back into commission only recently.

The projected annual production for this year is 55,000 tonnes comprising of 30,000 tonnes of burnt and 25,000 tonnes of chemically bonded basic bricks. The existing two tunnel kilns in the basic Plant have a total capacity of 40,000 tonnes saleable bricks per year and as such the increased projected output of 40,000 tonnes burnt bricks for the year 1973 is achievable provided there is no bottleneck in green manufacture. They have been granted a Letter of Intent for expanding their existing capacity by 20,000 tonnes for manufacture of chemically bonded basic bricks.

The exact details of additional plant and machinery required for the same have not yet been worked out and hence the second column of Annexure II-c is left blank.

XIII Belpahar Refractories Limited, Belpahar

Date of visit: 16-9-1971.

The licensed capacity of this unit is 40,000 tonnes of Firebricks, 20,000 tonnes of Silica Bricks and 50,000 tonnes of Basic Bricks. The actual figures for the year 1970 and anticipated production in coming years have been given in Annexure II-c.

Firebricks Section

Most of their production is by the dry process in the high grog quality. Their actual production for the year 1970 was 34,200 tonnes and their production for the first half of 1971 was 20,000 tonnes. This indicates a rate of production of 40,000 tonnes per year. A marginal increase up to 4,000 tonnes is proposed by 1973 by adding a periodic kiln.

The unit intends to expand their production further to 64,000 tonnes by 1975 subject to availability of industrial licence and other Government clearances.

Silica Section

The total silica production in 1970 was 8,500 tonnes and production up to August 1971 was 6,700 tonnes. In the year 1971 upto August, the production of coke oven silica was 2,000 tonnes, but it was mentioned that their second kiln came into production only in the latter half of this year and hence the total expected production in calendar year 1971 is 12,000 tonnes of silica including 5,000 tonnes of coke oven silica. Projected production in 1973 and 1975 was claimed as 20,000 tonnes of silica including 14,000 tonnes of coke oven.

As already mentioned, a new kiln identical to the old one, has been added. It was reported that additional facilities for crushing and grinding from indigenous sources are being arranged. It is also reported that they have ordered 4 Russian Friction Screw Presses each of 400 tonnes pressure mainly for use in silica coke oven. At present some of the presses of Fireclay and Basic Sections are being diverted towards silica production.

Assuming that they will be able to feed their kilns full swing out of existing and additional facilities in crushing, grinding and pressing sections, it is felt that the kiln will be bottleneck to achieve the production projected for the year 1973 onwards. From the kiln operation data given to the Team it was estimated that it will be extremely difficult to achieve a production of more than 17,000 tonnes of silica bricks with the product mix as indicated above.

Basic Section

In the first half of 1971 they achieved a total production of 20,000 tonnes, which amply justifies their projected annual production of 40,000 tonnes. Further increase in production is anticipated by addition of a new tunnel kiln, similar in dimensions as existing. Most of the imported components and erection drawings for the kiln have been obtained. The construction of the kiln is expected to start soon and completed within 6 to

8 months. It was also reported that they are taking adequate steps to procure the other required equipment from indigenous/imported sources to be able to feed the kiln. Up till now, availability of deadburnt magnesite had been restricting production, but with the likelihood of availability of Almora magnesite, this bottleneck is expected to be overcome.

XIV Hind Refractories Limited, Durgapur

Date of visit: 23-9-1971

The licensed capacity of this unit is 18,000 tonnes. The plant is presently engaged in manufacturing fire-bricks. The details of production in 1970 and anticipated production in the coming years is shown in Annexure II-a.

Production during 1970 has been 12,050 tonnes and the anticipated production projected for 1971 remains the same.

This unit manufactures recuperator tubes by extrusion process.

The envisaged increase in production by 1973 is both by plastic process as well as by dry process. To enable them to increase production by wet process by over 5,000 tonnes, they intend to take up construction of necessary kilns immediately. Orders for additional grinding machinery and presses are expected to be finalised soon.

The unit has an expansion scheme for manufacture of Firebricks by dry process to enable them to make 6,000 tonnes by 1973. The capital outlay anticipated is mentioned as Rs. 26 lakhs. They hope to place orders for crushing, grinding and screening equipments as well as for friction screw presses to be procured indigenously and also for construction of oil-fired chamber kilns. The construction of the shed to house the equipments is expected, to be soon taken up. If the steps are taken up as indicated, it is felt that the projected availability in 1973 is achievable.

GENERAL OBSERVATIONS

1. The Industry appeared to be conscious of the changeover from plastic to dry process and even the units in the Small Scale Sector were seriously considering setting up facilities for this changeover.

2. Units in the Organised Sector were taking effective steps to augment their production by installing additional equipment for manufacture of Firebricks by dry process. It was largely felt that production could be accelerated if import licences, whatever required, were issued promptly.

3. Production could be stepped up at a faster rate if the Refractory Producers were assured of the offtake and in this connection long term contracts for supplies to Steel Plants might be a source of confidence.

ANNEXURE II-A

FIRECLAY

(In tonnes)

	India Refractories		Reliance Firebricks	
	1	2	1	2
1. Licensed Capacity	36000	..	72000	..
2. Production in 1970:				
Total	18200	18200	20000	20000
Plastic Process	200	200	20000	20000
Dry Process	18000	18000	..	..
(i) High grog including High Alumina	14100	7100	..	..
(ii) Low grog	3900	10900	..	..
3. Production in 1971 (estimated):				
Total	20500	20500	30000	30000
Plastic Process	2000	2000	30000	30000
Dry Process	18500	18500	..	..
(i) High grog including High Alumina	15500	6000	..	..
(ii) Low grog	3000	12500	..	..
4. Production in 1973 (estimated):				
Total	25000	25000	40000	40000
Plastic Process	2000	2000	40000	40000
Dry Process	23000	23000	..	..
(i) High grog including High Alumina	19000	10000	..	..
(ii) Low grog	4000	13000	..	..
5. Production in 1975 (estimated)				
Total	25000	25000	50000	50000
Plastic Process	2000	2000	50000	.50000
Dry Process	23000	23000	..	..
(i) High grog including High Alumina	19000	19000	..	..
(ii) Low grog	4000	4000	..	..

NOTE.— Column 1 gives figures as reported by manufacturer.
Column 2 gives figures as assessed by this team.

ANNEXURE II-a (*Contd.*)

FIRECLAY

(In tonnes)

	Burn & Co Gulfarbari		Bihar Firebricks	
	1	2	1	2
1. Licensed Capacity	30000	..	50000*	..
2. Production in 1970:				
Total	23400	23400	19300	19300
Plastic Process	10800	10800	19300	19300
Dry Process	12600	12600	..	..
(i) High grog including High Alumina	..	..	..	..
(ii) Low grog	12600	12600	..	..
3. Production in 1971 (estimated)				
Total	27000	27000	21000	21000
Plastic Process	14600	14600	21000	21000
Dry Process	12400	12400	..	..
(i) High grog including High Alumina	..	..	..	..
(ii) Low grog	12400	12400	..	..
4. Production in 1973 (estimated):				
Total	30000	30000	24000	24000
Plastic Process	14000	14000	18000	18000
Dry Process	16000	16000	6000	6000
(i) High grog including High Alumina	..	..	..	..
(ii) Low grog	16000	16000	6000	6000
5. Production in 1975 (estimated)				
Total	30000	30000	24000	24000
Plastic Process	14000	14000	18000	18000
Dry Process	16000	16000	6000	6000
(i) High grog including High Alumina	..	..	..	..
(ii) Low grog	16000	16000	9000	9000

NOTE:— Column 1 gives figures as reported by manufacturer.
Column 2 gives figures as assessed by this team.

*including silica

ANNEXURE II-a (*Contd.*)

FIRECLAY

(In tonnes)

	Jharia Firebricks		Bharat Firebricks	
	1	2	1	2
1. Licensed Capacity	44000	..	..	..
2. Production in 1970:				
Total	6000	6000	9000	9000
Plastic Process	6000	6000	9000	9000
Dry Process	..	..	..	..
(i) High grog including High Alumina	..	..	..	..
(ii) Low grog	..	..	..	..
3. Production in 1971 (estimated):				
Total	13000	13000	10000	10000
Plastic Process	13000	13000	5000	5000
Dry Process	..	..	5000	5000
(i) High grog including High Alumina	..	..	..	..
(ii) Low grog	..	..	5000	5000
4. Production in 1973 (estimated):				
Total	20000	20000	14000	14000
Plastic Process	12000	12000	7000	7000
Dry Process	8000	8000	7000	7000
(i) High grog including High Alumina	..	..	..	..
(ii) Low grog	8000	8000	7000	7000
5. Production in 1975 (estimated):				
Total	20000	20000	14000	14000
Plastic Process	12000	12000	7000	7000
Dry Process	8000	8000	7000	7000
(i) High grog including High Alumina	..	..	..	..
(ii) Low Grog	8000	8000	7000	7000

NOTE:— Column 1 gives figures as reported by manufacturer.
Column 2 gives figures as assessed by this team.

ANNEXURE II-a (*Contd.*)

FIRECLAY

(In tonnes)

	KFS		IFICO	
	1	2	1	2
1. Licensed Capacity	13500**	..	72000	..
2. Production in 1970:				
Total	53100	53100	35000	35000
Plastic Process	17800	17800	..	..
Dry Process	35300	35300	35000	35000
(i) High grog including High Alumina	12300	12300	7700	7700
(ii) Low grog	23000	23000	27300	27300
3. Production in 1971 (estimated):				
Total	59600	59600	38000	38000
Plastic Process	18500	18500	..	..
Dry Process	41100	41100	38000	38000
(i) High grog including High Alumina	13600	13600	6000	6000
(ii) Low grow	27500	27500	32000	32000
4. Production in 1973 (estimated):				
Total	74500	74500	60000	50000
Plastic Process	16500	16500	..	..
Dry Process	58000	58000	60000	50000
(i) High grog including High Alumina	30000	30000	38500	28500
(ii) Low grow	30000	30000	21500	21500
5. Production in 1975 (estimated):				
Total	77000	77000	60000	60000
Plastic Process	8500	8500	..	..
Dry Process	68500	68500	60000	60000
(i) High grog including High Alumina	30000	30000	38500	38500
(ii) Low grog	38500	38500	21500	21500

NOTE:— Column 1 gives figures as reported by Manufacturer.
Column 2 gives figures as assessed by this team.

**including silica & specialities.

ANNEXURE II-a (*Contd.*)

FIRECLAY

(In tonnes)

	Orissa Indus. Latkata		Belpahar Refractories	
	1	2	1	2
1. Licensed Capacity	38000	..	40000	..
2. Production in 1970:				
Total	16400	16400	34233	34233
Plastic Process	..	..	..	..
Dry Process	16400	16400	34233	34233
(i) High grog including High Alumina	6500	6500	34233	34233
(ii) Low grog	9900	9900	..	
3. Production in 1971 (estimated):				
Total	21000	21000	40000	40000
Plastic Process	..	..	..	..
Dry Process	21000	21000	40000	40000
(i) High grog including High Alumina	6100	6100	40000	40000
(ii) Low grog	14900	14900	..	..
4. Production in 1973 (estimated):				
Total	36000	25000	44000	44000
Plastic Process	..	..	..	..
Dry Process	36000	25000	44000	44000
(i) High grog including High Alumina	21000	21000	44000	44000
(ii) Low grog	15000	16000	..	..
5. Production in 1975 (estimated):				
Total	38000	38000	64000	64000
Plastic Process	..	..	..	..
Dry Process	38000	38000	64000	64000
(i) High grog including High Alumina	21000	21000	64000	64000
(ii) Low grog	17000	17000	..	..

NOTE:— Column 1 gives figures as reported by manufacturer.
Column 2 gives figures as assessed by this team.

ANNEXURE II-a (*Contd.*)

FIRECLAY

(In tonnes)

	Orissa Cement Limited		Maithan Ceramics	
	1	2	1	2
1. Licenced Capacity	39000	..	..	..
2. Production in 1970:				
To al	32800	32800	4925	4925
Plastic Process	1000	1000	4925	4925
Dry Process	31800	31800	..	..
(i) High grow including High Alumina	21800	21800	..	..
(ii) Low grog	10000	10000	..	..
3. Production in 1971 (estimated):				
Total	37000	37000	14000	14000
Plastic Process	1800	1800	12000	13800
Dry Process	35200	35200	2000	2000
(i) High grog including High Alumina	24100	24100	..	
(ii) Low grog	11100	11100	2000	2000
4. Production in 1973 (estimated):				
Total	40000	40000	14350	14350
Plastic Process	2000	2000	10000	10000
Dry Process	38000	38000	4350	1750
(i) High grog including High Alumina	26000	26000	3600	...
(ii) Low grog	12000	12000	750	1750
5. Production in 1975 (estimated):				
Total	40000	40000	16400	16400
Plastic Process	2000	2000	10000	13600
Dry Process	38000	38000	6400	2800
(i) High grog including High Alumina	26000	26000	5400	
(ii) Low grog	12000	12000	1000	2800

NOTE.— Column 1 gives figures as reported by manufacturer.
Column 2 gives figures as assessed by this team.

ANNEXURE II-a (*Contd.*)

FIRECLAY

(In. tonnes)

	Jauhar Fire Bricks		Hind Refractories	
	1	2	1	2
1. Licensed Capacity	24000	..	18000	..
2. Production in 1970:				
Total	14000	14000	12650	12650
Plastic Process	13600	13600	12650	12650
Dry Process	400			
(i) High grog including High Alumina				
(ii) Low grog				
3. Production in 1971 (estimated):				
Total	14500	14500	12650	12650
Plastic Process	13000	14500	12650	12650
Dry Process	1500			
(i) High grog including High Alumina				
(ii) Low grog	1500			
4. Production in 1973 (estimated):				
Total	16500	16500	24000	24000
Plastic Process	14500	14500	18000	18000
Dry Process	2000	2000	6000	6000
(i) High grog including High Alumina	..	..	3600	3600
(ii) Low grog	2000	2000	2400	2400
5. Production in 1975 (estimated):				
Total	16500	16500	24000	24000
Plastic Process	14500	14500	18000	18000
Dry Process	2000	2000	6000	6000
(i) High grog including High Alumina	..	..	3600	3600
(ii) Low grog	2000	2000	2400	2400

NOTE.—Column 1 gives figures as reported by manufacturers.
Column 2 gives figures as assessed by this team.

ANNEXURE II—B

ANNEXURE II-b

SILICA

(In tonnes)

	Bihar Firebricks		KFS	
	1	2	1	2
1. Licensed Capacity	50000*	..	..	135000**
2. Production in 1970:				
Total	7500	7500	17200	17200
Coke Oven	1600	1600	3000	3000
Others	5900	5900	14200	14200
3. Production in 1971 (estimated):				
Total	7500	7500	20000	20000
Coke Oven	1800	1800	4000	4000
Others	5700	5700	16000	16000
4. Production in 1973 (estimated):				
Total	9000	9000	21000	21000
Coke Oven	4000	4000	6000	6000
Others	5000	5000	15000	15000
5. Production in 1975 (estimated):				
Total	9000	9000	22000	22000
Coke Oven	4000	4000	6000	6000
Others	5000	5000	16000	16000

N.B.—(1) *including fireclay.

(2) **including fireclay & specialities.

	Belpahar Refractories		Orissa Cement Ltd.	
	1	2	1	2
1. Licensed Capacity	20000	..	22000	..
2. Production in 1970:				
Total	8550	8550	10500	10500
Coke Oven	..	..	7400	7400
Others	..	..	3100	3100
3. Production in 1971 (estimated):				
Total	12000	12000	12000	12000
Coke Oven	5000	5000	6500	6500
Others	7000	7000	5500	5500
4. Production in 1973 (estimated):				
Total	20000	20000	23000	23000
Coke Oven	14000	14000	15000	15000
Others	6000	6000	8000	8000
5. Production in 1975 (estimated):				
Total	20000	20000	23000	23000
Coke Oven	14000	14000	16100	16100
Others	6000	6000	6900	6900

ANNEXURE II—C

ANNEXURE II-c

BASIC

(In tonnes)

	Belpahar Refractories	
	1	2
1. Licensed capacity	50000	..
2. Production in 1970: Total	37060	37060
Burnt	..	..
Chemically Bonded	..	..
3. Production in 1971 (estimated): Total	40000	40000
Burnt	20000	20000
Chemically Bonded	20000	20000
4. Production in 1973 (estimated): Total	45000	45000
Burnt	25000	25000
Chemically Bonded	20000	20000
5. Production in 1975 (estimated): Total	50000	50000
Burnt	38000	38000
Chemically Bonded	12000	12000

	Orissa Cement Limited	
	1	2
1. Licensed Capacity	48000	..
2. Production in 1970: Total	43400	43400
Burnt	28800	28800
Chemically Bonded	14600	14600
3. Production in 1971 (estimated): Total	55000	55000
Burnt	30000	30000
Chemically Bonded	25000	25000
4. Production in 1973 (estimated): Total	65000	65000
Burnt	40000	40000
Chemically Bonded	25000	25000
5. Production in 1975 (estimated): Total	75000	..
Burnt	42000	..
Chemically Bonded	33000	..

ANNEXURE III

ANNEXURE III

(In tonnes)

	India Refractories	Reliance	Burn & Co. Gulfarbari	Bihar Firebricks
	1	2	3	4
Capacities claimed for—				
(i) Holloware:				
1971	1800	9500	Nil	3200
1973	1800	11500	Nil	5800
1975	1800	13500	Nil	5800
(ii) Coke Oven fireclay shapes:				
1971	2200	2500	700	1800
1973	3200	3500	700	2400
1975	3200	5000	700	2400
(iii) Blast furnace bricks:				
1971	2500	Nil	750	Nil
1973	5000	Nil	750	Nil
1975	5000	Nil	750	Nil

	Jharia Firebricks	Bharat Firebricks	KFS	IFICO	Orissa Industries Latkata
	5	6	7	8	9
Capacities claimed for—					
(i) Holloware:					
1971	2200	500	2000	1500	Nil
1973	3000	1500	2500	3000	Nil
1975	3600	1500	2500	3000	2500
(ii) Coke Oven Firelcay shapes:					
1971	3600	500	1000	2000	2000
1973	3600	500	2400	2500	2000
1975	3600	500	2400	2500	2000
(iii) Blast furnace bricks:					
1971	Nil	Nil	Nil	2000	Nil
1973	Nil	Nil	2000	14500	4000
1975	Nil	Nil	4000	14500	4000

NOTE.— (1) Blast furnace capacity excludes capacity for stove and other accessories.

(2) Burn & Co. capacity for Blast furnace Limited for IISCO only.

ANNEXURE III—(*Contd.*)

(In tonnes)

	Belpahar Refractories	Orissa Cement	Maithon Ceramics
	10	11	12
Capacities claimed for:			
(i) Holloware:			
1971		1500	250
1973		1500	600
1975		1500	750
(ii) Coke Oven Fireclay shapes:			
1971		800	600
1973		800	1000
1975		800	1500
(iii) Blast furnace bricks:			
1971		2500	...
1973		2500	..
1975		2500	..

	Jauhar Firebricks	Hind Refractories
	13	14
Capacities claimed for:		
(i) Holloware:		
1971	1800	2400
1973	1800	3300
1975	1800	3300
(ii) Coke Oven Fireclay shapes:		
1971	500	300
1973	500	600
1975	500	600
(iii) Blast furnace bricks:		
1971	..	..
1973	..	..
1975	..	..

ANNEXURE IV

ANNEXURE IV

Production Capacity of the 14 Refractories Units During Period 1970-75

(In tonnes)

	1970	1971	1973	1975
FIRECLAY(x 1000 T)				
High grog & High Alumina	89.6	95.8	149.1	182.1
Low grog	93.7	115.4	135.6	140.2
Total dry Process	183.3	211.2	284.7	322.3
By Plastic Process	115.6	146.9	156.6	159.6
Total	298.9	358.1	441.3	481.9
BASIC				
SILICA	80460	95000	110000	1250000
Coke Oven	..	17300	39000	40100
Others	..	32700	34000	33900
Total	43700	50000	73000	74000

NOTE.— Capacity of Belpahar Refractories, as given by management, has been taken into account.

ANNEXURE M

ANNEXURE 'M'

Requirement of Special Refractories

Alloy Steel Plant, Durgapur

(In thousand Tonnes)

Type of Refractories		Consumption Norms 1969	Consumption Norms 1970	1971-72	72-73
INSULATION					
(i) Mica		..	..	..	..
(ii) Vermiculite		..	..	..	..
(iii) Diatomite		..	..	..	..
(iv) Fireclay base (v) Light weight fireclay (vi) Others		0.070	0.100	0.230	0.250
MORTARS					
(i) Fireclay		0.400	0.300	0.500	0.500
(ii) Silica		0.030	0.025	0.040	0.040
(iii) High Alumina		0.005	0.005	0.010	0.012
(iv) Basic		0.030	0.020	0.035	0.050
(v) Insulating		..	..	..	..
MASSES, CASTABLES					
(Carbon paste, carbon Ramming Mass, Tar dolomite Ramming Mass, Basic Ramming Mass, High Alumina Ramming Mass and others	1. Alumino Silicate Plastic.	0.075	0.060	0.100	0.125
	2. Insulating Castables	0.040	0.030	0.050	0.050
	3. Dense Castables	0.030	0.020	0.040	0.050
	4. Basic Ramming Mass	0.880	0.750	1.200	1.400
SPECIAL REFRACTORIES					
(Castables (special) silicon carbide High Alumina (above 75%) fuse cast, Graphite carbon blocks, Zircon refractories and any other types).	1. 92-94% Al_2O_3 Castable.	0.009	0.100	0.150	0.200
	2. Silicon Carbide shapes.	0.030	0.065	0.080	0.080
	3. 85% Al_2O_3	0.010	0.040	0.110	0.110
	4. Carbon Shapes	0.040	0.005	0.005	0.040
ACID PROOF BRICKS		0.010	0.060	0.075	0.080

NOTE :—Norms in Kg./Tonne are based on production in respective units.

Requirement of Special Refractories *Alloy Steels Plant, Durgapur.*

(In thousand Tonnes)

Type of Refractories		73-74	74-75	75-76	76-77
INSULATION					
(i) Mica		..	..	..	..
(ii) Vermiculite		..	..	..	..
(iii) Diatomite		..	..	..	..
(iv) Fireclay base (v) Light weight fireclay (vi) Others		0.250	0.250	0.250	0.250
MORTARS					
(i) Fireclay		0.500	0.500	0.510	0.500
(ii) Silica		0.042	0.043	0.044	0.044
(iii) High Alumina		0.015	0.015	0.015	0.015
(iv) Basic		0.052	0.052	0.052	0.052
(v) Insulating		..	..	..	..
MASSES, CASTABLES					
(Carbon paste, carbon Ramming Mass, Tar dolomite Ramming Mass, Basic Ramming Mass, High Alumina Ramming Mass and others)	1. Alumino Silicate Plastic.	0.130	0.110	0.110	0.110
	2. Insulating Castables	0.050	0.050	0.050	0.050
	3. Dense Castables	0.050	0.050	0.050	0.050
	4. Basic Ramming Mass	1.500	1.500	1.500	1.500
SPECIAL REFRACTORIES					
(Castables (special) silicon carbide, High Alumina (above 75% fuse cast, Graphite Carbon blocks, Zircon refractories and any other type).	1. 92-94% Al_2O_3	0.200	0.200	0.200	0.200
	2. Silicon Carbide Shapes	0.080	0.080	0.080	0.080
	3. 85% Al_2O_3	0.110	0.110	0.110	0.110
	4. Carbon Shapes	0.005	0.005	0.010	0.005
ACID PROOF BRICKS		0.085	0.085	0.085	0.085

Requirement of Special Refractories

Alloy Steels Plant,. Durgapur.

(In thousand Tonnes)

Type of Refractories		77-78	78-79	79-80
INSULATION				
(i) Mica		..	..	..
(ii) Vermiculite		..	..	..
(iii) Diatomite		..	..	..
(iv) Fireclay base (v) Light weight fireclay (vi) Others		0.250	0.250	0.250
MORTARS				
(i) Fireclay		0.510	0.500	0.510
(ii) Silica		0.044	0.044	0.044
(iii) High Alumina		0.015	0.015	0.015
(iv) Basic		0.052	0.052	0.052
(v) Insulating		..	..	
MASSES, CASTABLES				
(Carbon paste, Carbon Ramming Mass Tar dolomite Ramming Mass, Basic Ramming Mass, High Alumina Ramming Mass and others).	1. Alumino Silicate Plastic	0.110	0.110	0.110
	2. Insulating Castables	0.050	0.050	0.050
	3. Dense Castables	0.050	0.050	0.050
	4. Basic Ramming Mass	1.500	1.500	1.500
SPECIAL REFRACTORIES				
(Castables (special) slilicon carbide, High Alumina (above 75%) fuse cast Graphite Carbon blocks, Zircon refractories and any other type).	1. 92-94% Al_2O_3	0.200	0.200	0.200
	2. Silicon Carbide Shapes	0.080	0.080	0.080
	3. 85% Al_2O_3	0.110	0.110	0.110
	4. Carbon Shapes	0.005	0.040	0.005
ACID PROOF BRICKS		0.085	0.085	0.085

Requirement of Special Refractories

Bhilai Steel Plant,
Bhilai.

(In thousand Tonnes)

Type of Refractories	Consumption Norms Kg./ 1969 1970	1971 2.2	1972 2.4	1973 2.5
INSULATION				
(i) Mica	..	..	..	..
(ii) Vermiculate	..	0.022	0.024	..
(iii) Diatomite	0.010	..	..	0.025
(iv) Fireclay Bricks	..	..	..	..
(v) Light weight fireclay	0.210	0.460	0.500	0.520
(vi) Others	..	..	..	..
MORTARS				
(i) Fireclay	4.400	9.680	10.560	11.000
(ii) Silica	..	..	..	..
(iii) High Alumina	0.050	0.110	0.120	0.125
(iv) Basic	0.800	1.760	1.920	2.000
MASSES, CASTABLES				
(Carbon paste, carbon Ramming Mass, Tar dolomite ramming mass, Basic Ramming Mass, High Alumina Ramming Mass & others).	0.150	0.330	0.360	0.380
SPECIAL REFRACTORIES				
(Castables (special) silicon carbide, High Alumina (about 75%) fuse cast, Graphite carbon blocks, Sircon refractory and any other type).	0.060	0.130	0.140	0.150
ACID PROOF BRICKS				

Type of Refractories	1974 2.5	1975 3.0	1976 3.4
INSULATION			
(i) Mica	..	..	..
(ii) Vermiculate	..	..	..
(iii) Diatomite	0.025	0.03	0.034
(iv) Fireclay bricks	..	..	..
(v) Light weight fireclay	0.520	0.630	7.710
(vi) Others	..	..	..
MORTARS			
(i) Fireclay	11.000	13.200	14.960
(ii) Silica	..	..	
(iii) High Alumina	0.125	0.150	0.170
(iv) Basic	2.00	2.400	2.72
MASSES, CASTABLE			
(Carbon paste, carbon ramming mass, tardolomite ramming mass, basic ramming mass, high alumina ramming mass and others)	0.380	0.450	0.510
SPECIAL REFRACTORIES			
(Castables (special) Slilicon Carbide, High Alumina (about 75%) fuse cast, Graphite Carbon blocks, Zircon refractory and any other type).	0.150	0.180	0.200
ACID PROOF BRICKS			

NOTE:—Norms in Kg./Tonne are based on production in respective units.

Requirement of Special Refractories

Bhilai Steel Plant,
Bhilai.

Type of Refractories	1977 3.6	1978 3.8	1979 4.0
INSULATION			
(i) Mica	..	..	..
(ii) Vermiculate	..	..	..
(iii) Diatomite	0.036	0.038	0.040
(iv) Fireclay bricks	..	..	..
(v) Light weight fireclay	0.760	0.800	0.840
(vi) Others	..	..	..
MORTARS			
(i) Fireclay	15.840	16.720	17.600
(ii) Silica	..	..	..
(iii) High Alumina	0.180	0.190	0.200
(iv) Basic	2.880	3.040	3.200
MASSES, CASTABLES			
(Carbon paste, carbon Ramming Mass, Tar dolomite Ramming mass, Basic Ramming Mass, High Alumina Ramming Mass and others).	0.540	0.570	0.600
SPECIAL REFRACTORIES			
(Castables (special) silicon carbide, High Alumina (above 75%) fuse cast, Graphite Carbon blocks, Zircon refractory and any other type).	0.220	0.230	0.240
ACID PROOF BRICKS			

Requirement of Special Refractories

*Durgapur Steel Plant,
Durgapur.*

(In thousand tonnes)

Type of Refractory	Consumption Norms (Kg/T) 1969 1970	1971	1972	1973
INSULATION				
(i) Fireclay base		0.500	0.550	0.605
(ii) Light weight fireclay		0.400	0.200	0.200
(iii) Others		0.010	0.010	0.010
MORTARS				
(i) Fireclay		5.717	5.515	5.695
(ii) Silica		0.183	0.110	0.130
(iii) High Alumina		0.250	0.280	0.280
(iv) Basic		..	..	..
(v) Insulating		0.095	0.095	0.095
MASSES, CASTABLES				
High Alumina ramming mass & High Alumina pointing mass		0.125	0.130	0.135
SPECIAL REFRACTORIES				
High Alumina Cement		0.100	0.100	0.100
ACID PROOF BRICKS		0.030	0.030	0.030

Type of Refractories	1974	1975	1976	1977
INSULATING				
(i) Fireclay base	0.660	0.660	0.660	0.660
(ii) Light weight fireclay	0.400	0.200	0.200	0.200
iii) Others	0.010	0.010	0.010	0.010
MORTARS				
(i) Fireclay	5.995	5.995	5.995	5.995
(ii) Silica	0.130	0.130	0.130	0.130
(iii) High Alumina	0.280	0.280	0.280	0.280
(iv) Basic	..	..	..	..
(v) Insulating	0.095	0.095	0.095	0.095
MASSES, CASTABLES				
High Alumina ramming mass and High Alumina pointing mass	0.135	0.135	0.135	0.135
SPECIAL REFRACTORIES				
High Alumina Cement	0.100	0.100	0.100	0.100
ACID PROOF BRICKS	0.030	0.030	0.030	0.030

NOTE :—Norms in Kg./Tonne are based on production in respective units.

Requirement of Special Refractories

Rourkela Steel Plant,
Rourkela.

(In thousand Tonnes)

Type of Refractories	Consumption Norms 1969	1970	1971	1972
INSULATION				
(i) Mica	..	..	..	..
(ii) Vermiculite	ND	ND	0.005	0.005
(iii) Diatomite	..	..	..	..
(iv) Fireclay base	ND	ND	0.300	0.300
(v) Light weight fireclay	ND	ND	0.010	0.010
(vi) Others	..	..	..	..
MORTARS				
(i) Fireclay	ND	ND	4.600	5.000
(ii) Silica	ND	ND	0.100	0.450
(iii) High Alumina	ND	ND	0.050	0.060
(iv) Basic	ND	ND	0.300	0.350
(v) Insulating	ND	ND	0.030	0.030
MASSES, CASTABLES				
(Carbon paste, carbon Ramming Mass, Tar dolomite Ramming Mass, Basic Ramming Mass, High Alumina, Ramming Mass and others)				
Basic Ramming Mass and Castables	ND	ND	0.200	0.225
Fireclay Ramming Mass & Castables	ND	ND	0.400	0.300
High Alumina Ramming Mass & Cements	ND	ND	0.200	0.200
Tar Dolomite Ramming Mass	ND	ND	1.600	1.800
Coke-oven Spraying Compound	ND	ND	0.110	0.120
SPECIAL REFRACTORIES				
(Castables (special) silicon carbide, High Alumina (above 75%) fuse cast, Graphite carbon blocks, Zircon refractories and any other type).				
Plastic Refractories	ND	ND	0.254	0.254
Basalt Tiles	ND	ND	0.300	0.300
ACID PROOF BRICKS	ND	ND	0.640	..

NOTE:

1. ND Not Determined.
2. Norms in Kg/Tonne are based on production in respective units.

Requirement of Special Refractories

Rourkela Steel Plant, Rourkela.

(In Thousand Tonnes)

Type of Refractory	1973	1974	1975	1976
INSULATIONS				
(i) Mica	..	..	..	..
(ii) Vermiculite	0.005	0.005	0.005	0.005
(iii) Diatomite	..	..	..	..
(iv) Fireclay base	0.300	0.300	0.300	0.300
(v) Light weight fireclay	0.010	0.010	0.010	0.010
(vi) Others	..	..	..	..
MORTARS				
(i) Fireclay	5.000	5.000	5.000	5.000
(ii) Silica	0.450	0.450	0.450	0.450
(iii) High Alumina	0.060	0.060	0.060	0.060
(iv) Basic	0.350	0.350	0.350	0.350
(v) Insulating	0.030	0.030	0.030	0.030
MASSES, CASTABLES				
(Carbon paste, carbon Ramming Mass, Tar dolomite Ramming Mass, Basic Ramming Mass, High Alumina, Ramming Mass and others).				
Basic Ramming Mass and Castables	0.225	0.225	0.225	0.225
Fireclay Ramming Mass & Castables	0.200	0.300	0.300	0.400
High Alumina Ramming Mass and Cements	0.200	0.200	0.200	0.200
Tar Dolomite Ramming Mass	1.800	1.800	1.800	1.800
Coke-oven Spraying Compound	0.120	0.120	0.120	0.120
SPECIAL REFRACTORIES				
(Castables (special) silicon carbide, high Alumina (above 75%) Fuse Cast, Graphite carbon blocks, Zircon refractories and any other types).				
Plastic Refractories	0.254	0.254	0.254	0.254
Basalt Tiles	..	..	0.300	..
ACID PROOF BRICKS	0.640	..	0.640	..

NOTE:

Norms in Kg/Tonne are based on production in respective units.

Rourkela Steel Plant, Rourkela.

(In thousand Tonnes)

Type of Refractories	1977	1978	1979
INSULATION			
(i) Mica	..	..	—
(ii) Vermiculite	0.005	0.005	0.005
(iii) Diatomite	..	..	—
(iv) Fireclay base	0.300	0.300	0.300
(v) Light weight fireclay	0.010	0.010	0.010
(vi) Others	..	..	..
MORTARS			
(i) Fireclay	5.000	5.000	5.000
(ii) Silica	0.100	0.100	0.100
(iii) High Alumina	0.060	0.060	0.060
(iv) Basic	0.350	0.350	0.350
(v) Insulating	0.030	0.030	0.030
MASSES, CASTABLES			
(Carbon paste, carbon Ramming Mass, Tar Dolomite Ramming Mass, Basic Ramming Mass, High alumina Ramming Mass, and others).			
Basic Ramming Mass and Castables	0.225	0.225	0.225
Fireclay Ramming Mass and Castables	0.300	0.300	0.300
High Alumina Ramming Mass and Cements	0.200	0.200	0.200
Tar Dolomite Ramming Mass	1.800	1.800	1.800
Coke-oven Spraying Compound	0.120	0.120	0.120
SPECIAL REFRACTORIES			
(Castables (special) silicon carbide, High Alumina (above 75%) Fuse Cast, Graphite Carbon blocks, Zircon refractories and any other types).			
Plastic Refractories	0.254	0.254	0.254
Basalt Tiles	..	0.300	..
ACID PROOF BRICKS	0.640	..	0.640

28—1 D of S/ND/72

Requirement of Special Refractories

The Indian Iron & Steel Co. Ltd.

(In thousand tonnes)

Type of Refractories	Consumption Norms		Process Dry/Wet
	1969-70	1971-72 Provi-sional	
INSULATION			
(i) Mica	0.001	0.001	..
(ii) Vermiculite	0.171	0.174	Dry
(iii) Diatomite	..	..	..
(iv) Fireclay base	..	..	..
(v) Light Weight Fireclay	..	..	..
(vi) Others	..	..	..
MORTARS			
(i) Fireclay	8.272	6.149	Dry
(ii) Silica	1.473	1.958	Dry
(iii) High Alumina	0.084	0.099	Dry
(iv) Basic	0.418	0.439	Dry
(v) Insulating	0.010	0.010	Dry
MASSES, CASTABLES			
(i) Carbon paste	..	0.007	..
(ii) Carbon Ramming Mass	..	0.009	..
(iii) Tar dolomite Ramming Mass	..	..	..
(iv) Basic Ramming Mass	0.153	0.155	Dry
(v) High Alumina Ramming Mass	..	..	..
(vi) Others	..	..	..
SPECIAL REFRACTORIES			
(Castables special silicon carbide, High Alumina (above 75%) fuse cast, Graphite Carbon blocks, Zircon refractories and any other type)	..	0.200	..
ACID PROOF BRICKS	0.500	0.050	Dry
TOTAL	71.566	65.467	

NOTE:—Norms in Kg/Tonne are based on production in respective units.

Requirement of Special Refractories

The Indian Iron & Steel Co. Ltd.

(In Thousand Tonnes)

Type of Refractories	Process Dry/Wet	1971-72	1972-73	1973-74
INSULATION				
(i) Mica	..	0.001	0.001	0.001
(ii) Vermiculite	Dry	0.255	0.433	0.433
(iii) Diatomite	..	..	..	..
(iv) Fireclay base	..	..	..	..
(v) Light weight fireclay	..	..	..	..
(vi) Others	..	..	..	..
MORTARS				
(i) Fireclay	Dry	9.873	11.445	11.445
(ii) Silica	Dry	2.030	2.507	2.507
(iii) High Alumina	Dry	0.210	0.440	0.440
(iv) Basic	Dry	0.620	0.943	0.943
(v) Insulating	Dry	0.012	0.012	0.012
MASSES, CASTABLES				
(i) Carbon paste	..	0.009	0.010	0.010
(ii) Carbon Ramming Mass	..	0.013	0.016	0.016
(iii) Tar Dolomite Ramming Mass	..	..	..	..
(iv) Basic Ramming Mass	Dry	0.201	0.256	0.256
(v) High Alumina	..	..	..	..
(vi) Others	..	..	..	..
SPECIAL REFRACTORIES				
(Castables special silicon carbide, High Alumina, (above 75%) fuse cast, Graphite Carbon blocks, Zircon refractories and any other type)		0.278	0.324	0.324
ACID PROOF BRICKS	Dry	0.052	0.055	0.055
TOTAL		95.200	122.850	122.850

Requirement of Special Refractories

The Indian Iron & Steel Co. Ltd.

(In Thousand Tonnes)

Type of Refractories	Process Dry/Wet	1974-75	1975-76	1976-77
INSULATION				
(i) Mica	..	0.001	0.001	0.001
(ii) Vermiculite	Dry	0.433	0.433	0.433
(iii) Diatomite	..	..	..	..
(iv) Fireclay base	..	..	..	..
(v) Light Weight fireclay	..	..	..	..
(vi) Others	..	..	..	..
MORTARS				
(i) Fireclay	Dry	11.445	11.445	11.445
(ii) Silica	Dry	2.507	2.507	2.507
(iii) High Alumina	Dry	0.440	0.440	0.440
(iv) Basic	Dry	0.943	0.943	0.943
(v) Insulating	Dry	0.012	0.012	0.012
MASSES, CASTABLES				
(i) Carbon paste	..	0.010	0.010	0.010
(ii) Carbon Ramming Mass	..	0.016	0.016	0.016
(iii) Tar Dolomite Ramming Mass	..	..	..	..
(iv) Basic Ramming Mass	Dry	0.256	0.256	0.256
(v) High Alumina Ramming Mass	..	..	..	..
(vi) Others	..	..	..	..
SPECIAL REFRACTORIES				
(Castables (Special) silicon carbide, High Alumina (above 75%) fuse cast, Graphite Carbon blocks, Zircon refractories and any other type)		0.324	0.324	0.324
ACID PROOF BRICKS		0.055	0.055	0.055
TOTAL		122.850	122.850	122.850

Requirement of Special Refractories

The Indian Iron & Steel Co. Ltd.

(In Thousand Tonnes)

Type of Refractories	Process Dry/Wet	1977-78	1978-79	1979-80
INSULATION				
(i) Mica		0.001	0.001	0.001
(ii) Vermiculite	Dry	0.433	0.433	0.433
(iii) Diatomite		..	..	..
(iv) Fireclay base		..	..	..
(v) Light Weight fireclay		..	..	..
(vi) Others		..	..	..
MORTARS				
(i) Fireclay	Dry	11.445	11.445	11.445
(ii) Silica	Dry	2.507	2.507	2.507
(iii) High Alumina	Dry	0.440	0.440	0.440
(iv) Basic	Dry	0.943	0.943	0.943
(v) Insulating	Dry	0.012	0.012	0.012
MASSES, CASTABLES				
(i) Carbon paste		0.010	0.010	0.010
(ii) Carbon Ramming Mass		0.016	0.016	0.016
(iii) Tar Dolomite Ramming Mass		..	..	..
(iv) Basic Ramming Mass	Dry	0.256	0.256	0.256
(v) High Alumina Ramming Mass		..	..	..
(vi) Others		..	..	..
SPECIAL REFRACTORIES				
(Castables (special) silicon carbide, High Alumina (above 75%) fuse cast, Graphite Carbon blocks, zircon refractories and any other type)		0.324	0.324	0.324
ACID PROOF BRICKS		0.055	0.055	0.055
TOTAL		122.850	122.850	122.850

Requirement of Special Refractories

The Tata Iron & Steel Co. Ltd.

(In Thousand Tonnes)

Type of Refractories	Consumption in tonnes 1969	1970	1971	1972
INSULATION				
(i) Mica	..	..	..	..
(ii) Vermiculite	..	..	..	..
(iii) Diatomite (Superex)	0.063	0.022	0.025	0.060
(iv) Fireclay base	0.260	0.410	0.450	0.400
(v) Light weight fireclay	..	..	..	..
(vi) Hot face	0.117	0.105	0.150	0.150
MORTARS				
(i) Fireclay	8.995	11.260	12.000	12.000
(ii) Silica	1.730	1.940	2.000	2.000
(iii) High Alumina	2.470	2.580	2.500	2.500
(iv) Basic	0.960	1.220	1.500	1.500
(v) Insulating	0.085	0.100	0.120	0.100
MASSES, CASTABLES				
(i) Carbon paste	..	..	..	..
(ii) Carbon Ramming Mass	..	0.300	1.000	1.000
(iii) Tar Dolomite	..	..	..	..
(iv) Basic Ramming Mass	1.640	1.800	1.800	2.000
(v) High Alumina Ramming Mass	..	0.050	0.050	0.050
(vi) Others	0.780	0.985	1.100	1.100
GRANULATED REFRACTORIES				
Burnt Dolomite	39.800	41.200	42.000	43.000
Others	..	..	..	..
SPECIAL REFRACTORIES				
Special Castables	..	..	..	..
Silicon Carbide (Recuperator Tubes)	0.400 Nos	0.500 Nos	0.500 Nos	0.500 Nos
High Alumina (above 75%)	...	..	..	..
Fusion Cast	...	..	..	..
Graphite (Stopper heads)	0.150	0.150	0.500	0.500
Carbon blocks	..	..	..	..
Zircon Refractories	..	..	..	..
Besalt Tiles for Cyclones	...	...	0.050	0.050
ACID PROOF BRICKS	0.100	0.140	0.200	0.150

NOTE:—Norms in Kg/Tonne are based on production in respective units.

Requirement of Special Refractories

The Tata Iron & Steel Co. Ltd.

(In Thousand Tonnes)

Type of Refractories	1973	1974	1975
INSULATION			
(i) Mica	..	..	..
(ii) Vermiculite	..	..	..
(iii) Diatomite (Superex)	0.060	0.060	0.060
(iv) Fireclay base	0.400	0.400	0.400
(v) Light Weight fireclay	..	..	..
(vi) Hot face	0.1500	0.150	0.150
MORTARS			
(i) Fireclay	12.000	12.000	12.000
(ii) Silica	2.000	2.000	2.000
(iii) High Alumina	2.5000	2.5000	2.500
(iv) Basic	1.500	1.500	1.500
(v) Insulating	0.100	0.100	0.100
MASSES, CASTABLES			
(i) Carbon paste	..	..	..
(ii) Carbon Ramming Mass	1.000	1.000	1.000
(iii) Tar Dolomite	..	..	..
(iv) Basic Ramming Mass	2.000	2.000	2.000
(v) High Alumina Ramming Mass	0.050	0.050	0.050
(vi) Others	1.000	1.000	1.000
GRANULATED REFRACTORIES			
Burnt Dolomite	43.000	43.000	43.000
Others	..	...	...
SPECIAL REFRACTORIES			
Special Castables	..	..	..
Silicon Carbide (Recuperator Tubes)	600 Nos	600 Nos	600 Nos
High Alumina (above 75%)	..	..	..
Fusion Cast	0.050	0.050	0.050
Graphite (Stopper heads)	0.500	0.500	0.500
Carbon blocks	..	..	..
Zircon Refractories	..	..	..
Basalt Tiles for Cyclones	0.050	..	..
ACID PROOF BRICKS	0.150	0.150	0.150

Requirement of Special Refractories

The Mysore Iron & Steel Ltd., Bhadravati.

(In Thousand Tonnes)

Type of Refractories	Consumption Norms 1969	Consumption Norms 1970	1971	1972
INSULATION				
(i) Mica	..	..	0.040	0.040
(ii) Vermiculite	..	..	..	...
(iii) Diatomite	..	..	..	...
(iv) Fireclay base	..	..	..	..
(v) Light Weight fireclay	..	..	0.100	0.100
(vi) Others	..	..	..	...
MORTARS				
(i) Fireclay	..	..	2.600	2.600
(ii) Silica	..	..	0.125	0.125
(iii) High Alumina	..	..	0.050	0.050
(iv) Basic	..	..	0.125	0.125
(v) Insulating	..	..	0.025	0.025
MASSES, CASTABLES (Carbon Paste, Carbon temping paste Ramming Mass, Tar dolomite Ramming Mass, Basic Ramming Mass, High Alumina Ramming Mass and others)	..	..	0.625	0.600
SPECIAL REFRACTORIES (Castables (special) silicon carbide, High Alumina (above 75%) Fuse cast, Graphite Carbon blocks, Zircon refractories and any other types)	..	..	0.055	..
ACID PROOF BRICKS	..	..	..	..

Type of Refractories	1973	1974	1975	1976
INSULATION				
(i) Mica	0.040	0.040	0.040	0.040
(ii) Vermiculite	..	..	..	..
(iii) Diatomite	..	..	..	..
(iv) Fireclay base	..	..	..	..
(v) Light Weight fireclay	0.100	0.100	0.100	0.100
(vi) Others	..		..	..
MORTARS				
(i) Fireclay	2.600	2.600	2.600	2.600
(ii) Silica	0.125	0.125	0.125	0.125
(iii) High Alumina	0.050	0.050	0.050	0.050
(iv) Basic	0.125	0.125	0.125	0.125
(v) Insulating	0.025	0.025	0.025	0.025
MASSES, CASTABLES (Carbon paste, carbon temping paste, Ramming Mass, dolo-Tar dolomite Ramming Mass, Basic Ramming Mass, High Alumina Ramming Mass, and others)	0.700	0.625	0.600	0.600
SPECIAL REFRACTORIES (Castables (special) silicon carbide, High Alumina (above 75%) fuse cast, Graphite carbon blocks, A Zircon refractories and any other types)	0.030	..	..	..
ACID PROOF BRICKS	..	..	..	..

NOTE:—Norms in kg/Tonne are based on production in respective units.

Requirement of Special Refractories

The Mysore Iron & Steel Ltd.,
Bhadravati.

(In Thousand Tonnes)

Type of Refractories	1977	1978	1979
INSULATION			
(i) Mica	0.040	0.040	0.040
(ii) Vermiculite	..	..	..
(iii) Diatomite	..	..	..
(iv) Fireclay base	..	..	..
(v) Light weight fireclay	0.100	0.100	0.100
(vi) Others	..	..	..
MORTARS			
(i) Fireclay	2.600	2.600	2.600
(ii) Silica	0.125	0.125	0.125
(iii) High Alumina	0.050	0.050	0.050
(iv) Basic	0.125	0.125	0.125
(v) Insulating	0.025	0.025	0.025
MASSES, CASTABLES			
(Carbon paste, carbon temping paste, Ramming Mass, Tar dolomite Ramming Mass, Basic Ramming Mass, High Alumina Ramming Mass and others)	0.725	0.600	0.600
SPECIAL REFRACTORIES			
(Castables (special) silicon carbide, High Alumina (above 75 %) fuse cast, Graphite carbon blocks, Zircon refractories and any other types)	0.085	..	..
ACID PROOFBRICKS	..	..	..

Requirement of Special Refractories

Bokaro Steel Limited.

(In Thousand Tonnes)

Type of Refractories	1971	1972	1973
INSULATION			
(i) Mica	1.397	1.397	1.397
(ii) Vermiculite	0.188	..	..
(iii) Diatomite	..	..	..
(iv) Fireclay base	..	..	..
(v) Light weight fireclay	1.521	1.521	1.521
(vi) Others	..	5.864	7.000
MORTARS			
(i) Fireclay	2.000	..	..
(ii) Silica	1.400	2.880	1.460
(iii) High Alumina	0.150	0.289	0.164
(iv) Basic	0.029	0.050	0.050
(v) Insulating	0.750	0.750	0.228
MASSES, CASTABLES			
(Carbon paste, Carbon Ramming Mass, Tar dolomite Ramming Mass, High Alumina Ramming Mass & others)	0.300	0.315	0.300
Carbon	..	0.035	0.035
Tar bonded dolomite	..	1.350	1.350
SPECIAL REFRACTORIES :			
Carbon blocks	0·636	0·636	0·636
Carborundum	..	0·300	0·147
Carborundum tiles	..	0·060	0·060
Carbon Mass	0·183	0·183	0·183
ACID PROOF BRICKS :			
Larmier Bricks	0·040	0·040	..
Acid Proof Bricks	0·700	0·306	0·246
Acid proof Tiles, Rings and Pipes	0·070	0·063	0·063

Requirement of Special Refractories

Bokaro Steel Limited.

(In Thousand Tonnes)

Type of Refractories	1974	1975	1976
INSULATION			
(i) Mica	0.842	0.830	0.295
(ii) Vermiculate	..	..	..
(iii) Diatomite	..	..	..
(iv) Fireclay base	..	..	..
(v) Light weight fireclay	2.270	1.230	0.102
(vi) Others	8.758	..	..
MORTARS			
(i) Fireclay	..	8.058	8.238
(ii) Silica	1.498	2.308	1.558
(iii) High Alumina	0.227	0.224	0.044
(iv) Basic	0.100	0.042	..
(v) Insulating	0.704	0.413	0.100
MASSES, CASTABLES			
(Carbon paste, Carbon Ramming Mass, Tar dolomite Ramming Mass, High Alumina Ramming Mass and others)	0.389	0.183	..
Carbon	0.070	0.092	0.103
Tar bonded dolomite	1.975	2.700	3.550
SPECIAL REFRACTORIES :			
Carbon blocks	0·636	0·636	..
Carborundum	0·300	0·147	..
Carborundum Tiles	..	0·060	..
Carbon Mass	0·183	0·183	..
ACID PROOF BRICKS :			
Larmier Bricks	0·040	..	...
Acid Proof Bricks	0·700	..	..
Acid Proof Tiles, Rings and Pipes	0·018	..	..

Requirement of Special Refractories

Bokaro Steel Limited.

(In Thousand Tonnes)

Type of Refractories	1977	1978	1979
INSULATION			
(i) Mica	..	..	..
(ii) Vermiculite	..	..	..
(iii) Diatomite	..	..	..
(iv) Fireclay base	..	..	..
(v) Light weight fireclay	..	..	..
(vi) Others	..	..	..
MORTARS			
(i) Fireclay	13.610	13.610	13.610
(ii) Silica	0.175	0.175	0.175
(iii) High Alumina	0.045	0.045	0.045
(iv) Basic	..	..	..
(v) Insulating	0.200	0.200	0.200
MASSES, CASTABLES			
(Carbon paste, Carbon Ramming Mass, Tar dolomite Ramming Mass, High Alumina Ramming Mass and others) Carbon	0.115	0.115	0.115
Tar bonded dolomite	6.400	6.400	6.400
SPECIAL REFRACTORIES			
Carbon blocks	..	..	..
Carborundum	..	..	..
Corborundum Tiles	..	..	..
Carbon Mass	..	..	..
ACID PROOF BRICKS :			
Larmier Bricks	..	..	..
Acid Proof Bricks	..	..	..
Acid Proof Tiles, Rings and Pipes	..	..	..

Operation and Construction Requirements of Special Refractories for Bhilai Expansion and new Plants

Name of Refractories	Name of the Plant		1973	1974	1975
INSULATION :	Bhilai	O	..	..	..
		C	1·800	3·600	1·800
	Salem	O	..	..	..
		C	0·200	0·200	0·200
	Vizag	O	..	..	..
		C	1·250	1·250	1·250
	Hospet	O	..	..	..
		C	2·500	2·500	2·500
	St. Pl. I	O	..	..	..
		C	..	..	2·500
	St. Pl. II	O	..	..	..
		C	..	..	..
	St. Pl. III	O	..	..	..
		C	..	..	..
	St. Pl. IV	O	..	..	..
		C	..	..	..
	St. Pl. V	O	..	..	..
		C	..	..	..
	TOTAL		2·000	7·550	8·250

Name of Refractories	Name of the Plant		1976	1977	1978
INSULATION :	Bhilai	O	..	..	..
		C	..	..	..
	Salem	O	..	0·030	0·050
		C	..	..	..
	Vizag	O	..	0·150	0·225
		C	1·250	1·250	..
	Hospet	O	..	1·500	2·250
		C	2·500	2·500	..
	St. Pl. I	O	..	..	1·500
		C	2·500	2·500	2·500
	St. Pl. II	O	..	..	..
		C	2·500	2·500	2·500
	St. Pl. III	O	..	..	..
		C	..	2·500	2·500
	St. Pl. IV	O	..	..	..
		C	..	..	2·500
	St. Pl. V	O	..	..	..
		C	..	..	..
	TOTAL		8·250	12·930	14·025

Operation and Construction Requirements of Special Refractories for Bhilai Expansion and new Plants

Name of Refractories	Name of the Plant		1973	1974	1975
MORTARS, MASSES CASTABLES AND GRANULATED REFRACTORIES ETC.	Bhilai	O	..	..	..
		C	1·500	1·500	1·550
	Salem	O	..	..	..
		C	0·400	0·300	0·300
	Vizag.	O	..	..	..
		C	..	3·000	3·000
	Hospet	O	..	..	..
		C	..	7·000	7·000
	St. Pl. I	O	..	..	..
		C	..	..	7·000
	St. Pl. II	O	...	..	..
		C	..	..	..
	St. Pl. III	O	..	..	..
		C	..	..	..
	St. Pl. IV	O	..	..	..
		C	..	..	..
	St. Pl. V	O	..	..	..
		C	..	..	..
		TOTAL	1·900	11·800	18·850

Name of Refractories	Name of the Plant		1976	1977	1978
MORTARS, MASSES CASTABLES AND GRANULATED REFRACTORIES ETC.	Bhilai	O	..	..	..
		C	..	..	..
	Salem	O	0·900	1·500	1·500
		C	..	..	..
	Vizag.	O	..	8·500	13·750
		C	3·000	3·000	...
	Hospet	O	..	6·000	9·000
		C	7·000	7·000	..
	St. Pl. I	O	..	..	6·000
		C	7·000	7·000	7·000
	St. Pl. II	O	..	..	..
		C	7·000	7·000	7·000
	St. Pl. III	O	..	..	..
		C	..	7·000	7·000
	St. Pl. IV	O	..	..	..
		C	..	..	..
	St. Pl. V	O	..	..	..
		C	..	..	..
		TOTAL	26·900	47·000	58·250

Operation and Construction Requirements of Special Refractories for Bhilai Expansion and new Plants

Name of Refractories	Name of the Plant		1979	1980	1981
INSULATION :	Bhilai	O	..	..	..
		C	..	..	..
	Salem	O	0·050	0·050	0·050
		C	..	..	..
	Vizag	O	0·300	0·300	0.300
		C	..	..	..
	Hospet	O	3·000	3·000	3·000
		C	..	..	..
	St. Pl. I	O	2·250	3·000	3·000
		C	..	..	..
	St. Pl. II	O	1·500	2·250	3·000
		C	2·500	..	..
	St. Pl. III	O	..	1·500	2·250
		C	2·500	2·500	..
	St. Pl. IV	O	..	..	1·500
		C	2·500	2·500	2·500
	St. Pl. V	O	..	..	..
		C	2·500	2·500	2·500
		TOTAL	17·100	17·600	18·100

Name of Refractories	Name of the Plant		1982	1983	1984	1985
INSULATION :	Bhilai	O	..	..	..	..
		C	..	..	..	..
	Salem	O	0.050	0·050	0·050	0·050
		C	—	..	..	..
	Vizag.	O	0.300	0·300	0·300	0·300
		C	..	..	..	..
	Hospet	O	3·000	3·000	3·000	3·000
		C	..	..	..	..
	St. Pl. I	O	3·000	3·000	3·000	3·000
		C	..	..	..	..
	St. Pl. II	O	3·000	3·000	3·000	3·000
		C	..	..	..	..
	St. Pl. III	O	3·000	3·000	3·000	3·000
		C	..	..	..	..
	St. Pl. IV	O	2·250	3·000	3·000	3·000
		C	..	..	..	..
	St. Pl. V	O	1·500	2·250	3·000	3·000
		C	2·500	..	..	..
		TOTAL	18·600	17·600	18·350	18·350

O : Operational.
C : Capital Repair.

Operation and Construction Requirements of Special Refractories for Bhilai Expansion and new Plants

Name of Refractories	Name of the Plant		1979	1980	1981
MORTARS,	Bhilai	O	..	..	..
MASSES		C	..	..	..
CASTABLES	Salem	O	1·500	1·500	1·500
AND		C	..	..	..
GRANULATED	Vizag.	O	19·000	19·000	19·000
REFRACTORIES		C	..	..	..
ETC.	Hospet	O	12·000	12·000	12·000
		C	..	..	..
	St. Pl. I	O	9·000	12·000	12·000
		C	..	..	..
	St. Pl. II	O	6·000	9·000	12·000
		C	7·000	..	..
	St. Pl. III	O	..	6·000	9·600
		C	7·000	7·000	..
	St. Pl. IV	O	..	..	6·000
		C	2·000	7·000	7·000
	St. Pl. V	O	..	..	..
		C	7·000	7·000	7·000
		TOTAL	75·500	80·500	85·500

Name of Refractories	Name of the Plant		1982	1983	1984	1985
MORTARS	Bhilai	O	..	..	..	..
MASSES		C	..	..	..	..
CASTABLES	Salem	O	1·500	1·500	1·500	1·500
AND		C	..	..	..	..
GRANULATED	Vizag.	O	19·000	19·000	19·000	19·000
REFRACTORIES		C	..	..	..	..
ETC.	Hospet	O	12·000	12·000	12·000	12·000
		C	..	..	..	..
	St. Pl. I	O	12·000	12·000	12·000	12·000
		C	..	..	..	..
	St. Pl. II	O	12·000	12·000	12·000	12·000
		C	..	..	..	..
	St. Pl. III	O	12·000	12·000	12·000	12·000
		C	..	..	..	..
	St. Pl. IV	O	9·000	12·000	12·000	12·000
		C	..	..	..	..
	St. Pl. V	O	6·000	9·000	12·000	12·000
		C	7·000	..	..	..
		TOTAL	90·000	89·500	92·500	92·500

O : Operational.

C : Capital Repair.

Operation and Construction Requirements of Special Refractories for Bhilai Expansion and new Plants

Name of Refractories	Name of the Plant		1979	1980	1981
SPECIAL REFRACTORIES	Bhilai	O	..	..	..
		C	..	..	..
	Salem	O	..	..	..
		C	..	..	..
	Vizag.	O	..	..	..
		C	..	..	..
	Hospet	O	0·900	0·900	0·900
		C	..	..	..
	St. Pl. I	O	0·675	0·900	0·900
		C	..	..	..
	St. Pl. II	O	0·450	0·675	0·900
		C	0·750	..	..
	St. Pl. III	O	..	0·450	0·675
		C	0·750	0·750	..
	St. Pl. IV	O	..	..	0·450
		C	0·750	0·750	0·750
	St. Pl. V	O	..	..	..
		C	0·750	0·750	0·750
		TOTAL	5·025	5·175	5·325

Name of Refractories	Name of the Plant		1982	1983	1984	1985
SPECIAL REFRACTORIES	Bhilai	O	..	..	..	..
		C	..	..	..	..
	Salem	O	..	..	..	..
		C	..	..	..	..
	Vizag.	O	..	..	..	..
		C	..	..	..	..
	Hospet	O	0.900	0.900	0.900	0.900
		C	..	..	..	..
	St. Pl. I	O	0.900	0.900	0.900	0.900
		C	..	..	..	..
	St. Pl. II	O	0.900	0.900	0.900	0.900
		C	..	..	..	..
	St. Pl. III	O	0.900	0.900	0.900	0.900
		C	..	..	..	..
	St. Pl. IV	O	6.755	0.900	0.900	0.900
		C	..	..	..	..
	St. Pl. V	O	0.450	0.675	0.900	0.900
		C	0.750	..	..	..
		TOTAL	5.475	5.175	5.400	5.400

O : Operational.
C : Capital Repair.

ANNEXURE N

****Glossary of terms commonly used in connection with refractories and furnaces***

Abrasion : The wearing away of a surface due to rubbing action, e.g., by dust-laden gases, or slabs on a hearth.

Absorption : The ratio of the weight of fluid (normally water) which can be absorbed by a material to the dry weight. Usually expressed as a percentage.

Bond : A material added to (or already present in) a refractory batch, whose function is to promote strength either in the green, dry or fired state. The same term is applied to the various methods of building bricks whereby adjacent courses are tied into one another.

Bulk Density : The ratio of the weight of a material to its total volume (i.e., including pore space). Expressed as g.p.ml. (g.p.c.c.) or lb. per cu. ft.

Calcination : Heat treatment applied to certain rocks and minerals to effect dissociation (and/or produce a change in physical structure), e.g., clay is calcined to drive off combined water.

Campaign : The working life of a furnace between major repairs.

Castable Refractory : A hydraulic setting refractory suitable for casting into shapes and usually bonded with aluminous cement.

Ceramic : A general term applied to all materials made from clayey and earthy substances by the application of heat.

Corrosion : Wearing away of a material, e.g., furnance brickwork, by chemical action of fluxes.

Dead-Burned : Applied to materials which have been fired to a temperature sufficiently high to render them relatively resistant to moisture and free from excessive after-contraction, e.g., dead burned magnesite.

Density : The weight of unit volume of a substance (see also Bulk Density).

Erosion : The wearing away of a material. Usually applied to wear caused by physical rather than chemical forces ; cf. CORROSION and ABRASION.

Flux : A material which lowers the fusion point of a refractory material.

Fusion : The softening of a solid material by heat alone or by the combined action of heat and fluxes.

Gangue : Accessory minerals associated with relatively valuable minerals.

Green Strength : The strength of a ceramic body in the moulded but unfired state.

Grog : Non-plastic material, usually prefired, added to a brick batch to reduce drying and firing shrinkage, or obtain special properties, e.g., high thermal shock resistance.

Monolithic Lining : A lining containing no joints which is formed by ramming or sintering into position a granular material.

Orton Cones : Standard pyrometric cones as used in U.S.A.

Plasticity : The property of a material by virtue of which it can be moulded into any desired form, and which retains that form when the pressure of moulding has been removed.

Porosity : The ratio of the volume of pores in a refractory body to the volume of the entire body. Usually expressed as a percentage

If P=Porosity (per cent), B.D.=Bulk

Density (g.p. ml.) and A.S.G.=Apparent Specific Gravity, then

$$\text{Porosity} = P = 100 \left\{ 1 - \frac{B.D.}{A.S.G.} \right\}$$

Pyrometric cones : Small pyramid-shaped pieces of mixtures of minerals which melt at definite temperature under standardised conditions. They are used as a basis for comparison in the determination of the pyrometric Cone Equivalent or refractoriness of refractory materials.

Pyrometric Cone Equivalent (P.C.E.) : In the determination of refractoriness, the test cone is heated up in company with standard cones whose deformation temperature is known. The P.C.E. value is that of the cone or cones which deform at the nearest temperature to that at which the test cone deforms. A cone is said to have deformed (or melted) when it has bent over until the tip is on a level with the base

Recuperator : A continuous heat exchanger in which heat is extracted from the products of combustion and returned to incoming air through metal or refractory walls.

Refractoriness : A term used as an index of the heat resisting properties of refractories. It is usually determined on a sample in the form of a cone cut or prepared from the ground refractory.

Refractoriness-under-load : A measure of the resistance of a refractory to the combined effects of heat and loading. Often expressed as the temperature of shear or 10 per cent deformation when heated up under 25 or 50 lb. per sq. in.

Regenerator : A cycle heat exchanger which alternately receives heat from combustion products and transfers heat to air or gas used in combustion.

Skull : The crust of solid metal left in a ladle due to premature cooling of the metal.

Slag : Material formed by fusion of oxides in metallurgical processes. May also be applied to fused reaction product between a refractory and a flux.

Spalling : "Breaking or cracking of refractory brick in service, to such an extent that pieces are separated or fall away, leaving new surfaces of the bricks exposed".

Thermal Conductivity : The property by virtue of which heat is transmitted through matter.

Thermal Expansion : The increase in dimensions of a material when heated. The term is only applied to that part of the expansion which is reversible and should not be confused with the permanent expansion whieh occurs when some substances are heated (cf. after-expansion).

Thermal Shock Resistance : The ability to withstand sudden heating or cooling with out cracking

** Source—Steel Plant Refractories by Chesters.

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